

# PUBLIC WORKS

**Oct.**  
**1956**

**CITY, COUNTY AND STATE**

**Essential Elements in  
Municipal BOND RATINGS**  
page 91

**Water and Sewage  
CHEMISTRY and  
CHEMICALS**

A complete text with  
full-color illustrations  
pages 99 to 114

**WINTER PROBLEMS  
on the Ohio Turnpike**  
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**New Devices Improve  
TRAFFIC CONTROL**  
page 131

**COMPLETE CONTENTS  
LIST ON PAGE 5**



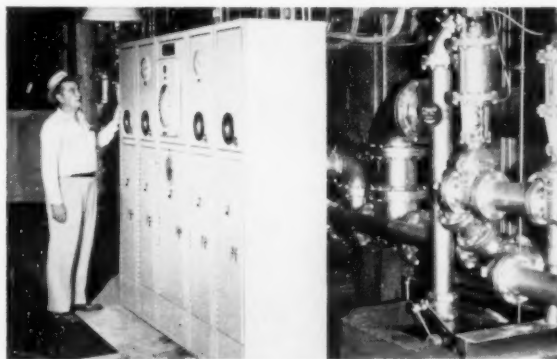
Ray Lawrence is Principal Engineer in  
Black & Veatch, Consulting Engineers, and  
is a member of the firm. More on page 11

UNIVERSITY MICROFILMS  
313 N 1ST ST  
ANN ARBOR MICH 48106

# HOLLYWOOD (Florida) SAVES \$32,980 A YEAR regenerating its softeners with sea water



1. Pumps draw sea water from wells beneath this station. Being inland, these wells deliver a partially filtered sea water. (Regenerating costs are now \$25 less per million gallons than when dry salt was used.)



4. City Engineer George A. Gieseke inspects the Permutit control panel. It backwashes, regenerates and rinses the 4 newest softeners and places them on the line . . . all without aid from the plant operator! Two men per shift operate the entire water plant.



2. To prevent marine growths which would foul equipment, the sea water is aerated and chlorinated.



5. Hollywood is growing fast. Their first four Permutit softeners went on the line twenty years ago. Now there are 12 . . . and plant space for more. "We're in good shape," says City Engineer Gieseke.



3. Sea water then passes through Permutit pressure filters (left) and is ready for regenerating the Permutit softeners (right). Sea water pumpage is kept to a minimum because high-capacity Permutit Q, used in the softeners, requires less salt for regeneration

It's easy to see why Consulting Engineers *Reynolds, Smith & Hills* chose Permutit equipment . . . for its long service life and low operating costs. And we'll be glad to help you make sure your water supply is "in good shape" for the future. Write to: Dept. PW-10, The Permutit Company, 330 West 42nd Street, New York 36, New York.

WATER CONDITIONING HEADQUARTERS

## PERMUTIT



## These cards help make YOUR JOB EASIER!

Here's the way you can get free, up-to-date catalogs, booklets, and service information about new products . . . new equipment . . . that will help you do your job faster . . . better . . . cheaper!

Look on pages 32 to 52 and 199 to 203 for the free data books you want . . . then circle the numbers on this handy, postage-free card and mail it to us today!

**You'll be a big help to us, too!**

We've got to verify your name and address once a year to keep on sending PUBLIC WORKS to you. Your catalog-request card helps us out. Thanks a million!

10-56

**USE THIS CARD to get detailed information!**

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Occupation

Street

City

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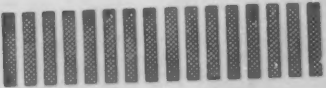
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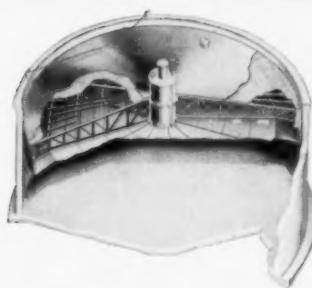
**"Chicago"**  
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**POSITIVE NON-TIPPING  
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# Chicago-Wiggins Digester Covers and Gas Holders!

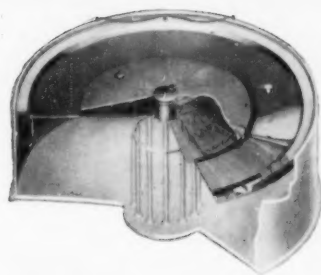
In addition to their known non-tipping characteristics, Chicago-Wiggins Covers offer the following advantages:

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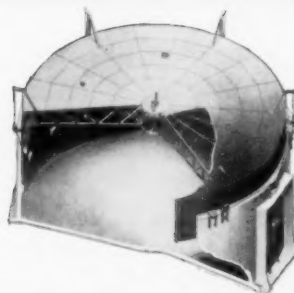
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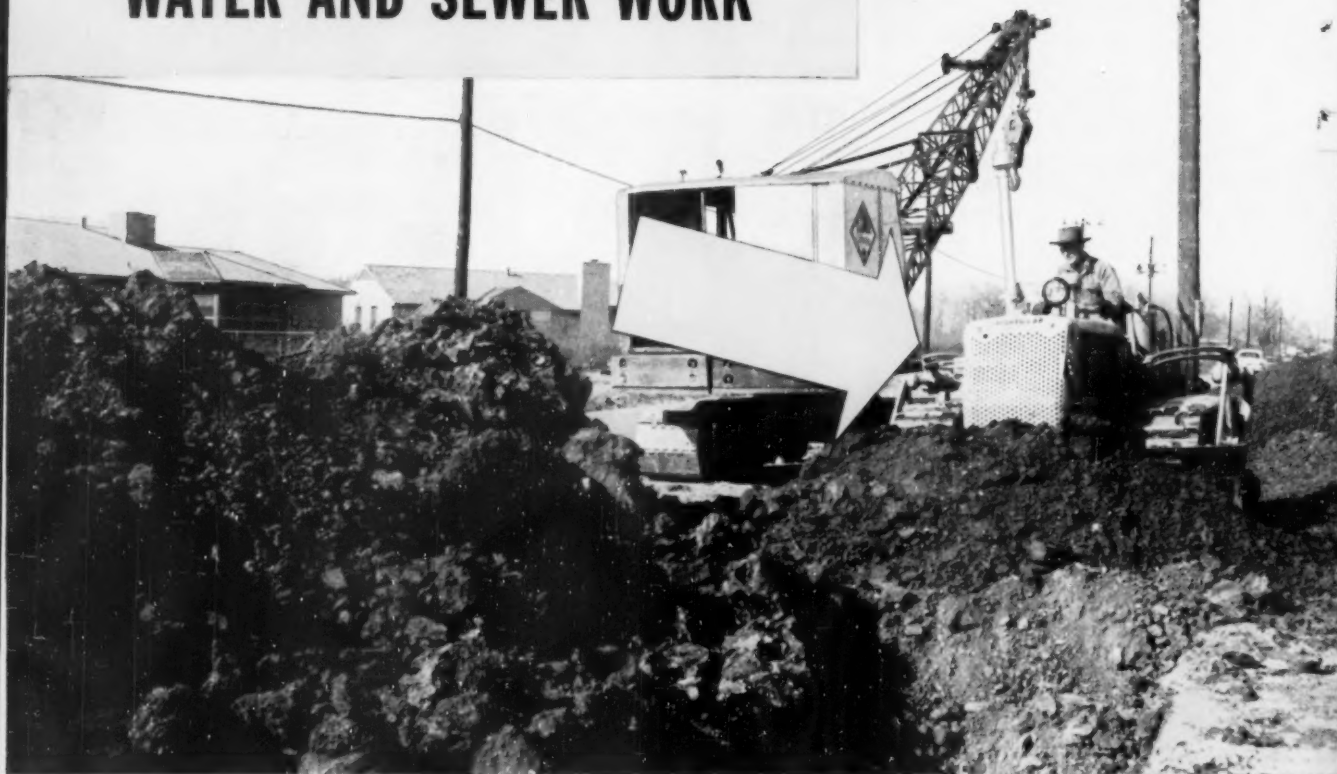
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# HOW A **CAT\* D4** TRACTOR SPEEDS WATER AND SEWER WORK



In the whole Caterpillar line of crawler tractors, the D4 probably best fits the needs of the average municipality. It's big enough to do a multitude of jobs well—small enough to give maximum economy and mobility.

The D4 Tractor with No. 4A Bulldozer shown here is owned by the City of Tulsa, Oklahoma. On this particular job the city is laying 16,000 feet of 24-inch water main. All the backfilling is handled neatly and quickly by the Cat-built unit.

There is plenty of work all year round for such a machine. It can be used not only for water and sewer jobs but for stockpiling road materials, feeding the shovel in gravel pits and removing snow in winter.

The D4 is ruggedly built to stand up in tough going. Its dependable 4-cycle, 4-cylinder engine delivers 50 drawbar HP at 1600 RPM. The Caterpillar fuel injection system is simple and foul-free, permitting the use of thrifty, low-cost fuels. Five forward speeds give the tractor a range up to 6.1 MPH.

Final drive, track rollers and idlers are equipped with bellows-type seals, effective in keeping out mud and dust and lengthening work life. Operators like the D4's seat comfort, good visibility and ease of operation and maintenance.

Check over your equipment now. If you're in the market for an all-around tractor-bulldozer unit, give your Caterpillar Dealer a call. He'll be glad to demonstrate a machine on your job and prove with actual figures how it can save the taxpayers' money. He backs the equipment he sells with reliable service and parts you can trust.

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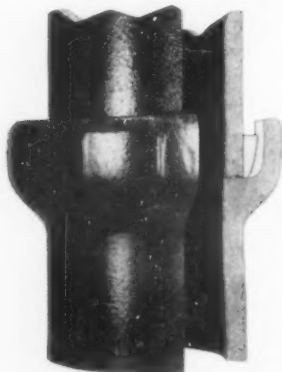
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THE MOST USEFUL ENGINEERING MAGAZINE  
FOR CITIES, COUNTIES AND STATES

# Sewer line installed faster at lower cost with **AMVIT\* JOINTED CLAY PIPE**



No other materials such as caulking, joint compound, joint runners, hot-pots or ladles are needed to make the Amvit Joint. Installation is quick and easy. The joint is on the pipe delivered to the job ready for use. Nothing else is needed. Just push the pipe together and the joint is complete. Savings on materials and labor with Amvit Jointed Clay pipe mean *lower cost of pipe in place*.

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Amvit Jointed Clay pipe, in sizes 4" through 24", together with all fittings is available for immediate delivery in the Northeast and Central States.

For more information, write or call American Vitriified Products Co., National City Bank Bldg., Cleveland, Ohio, or our office nearest you.



*The Amvit Joint is made of a plastic material with rubber-like characteristics. Like the pipe, the joint will withstand the most severe underground conditions. Amvit Joint is also furnished on all standard fittings.*

SINCE 1900



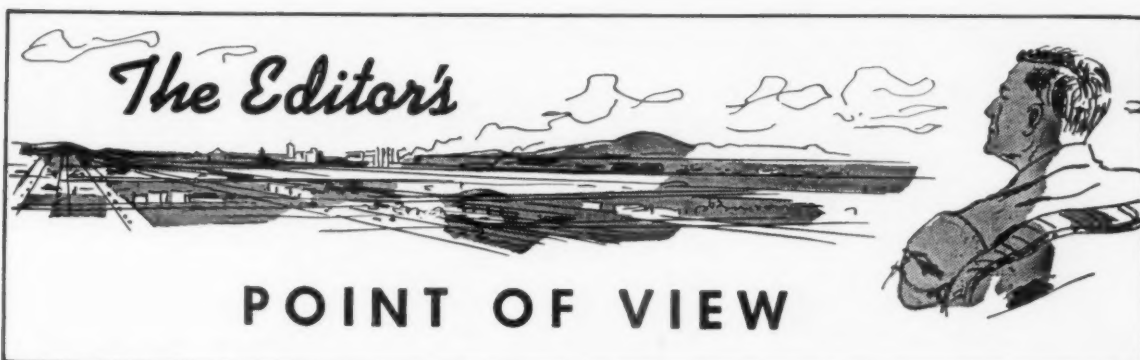
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### Young Engineers and the Big New Highway Program

**M**ANY young engineers are going to be attracted to highway design and construction by the recently authorized Federal highway program. Not only will there be an opportunity for a lifetime of interesting work, but engineers, already in short supply, will be needed to make the wheels go around. This means at least reasonably attractive salaries and security in their jobs.

But pay, though important, is only one item. It is necessary to utilize these engineering skills quickly; and to develop the young men who have been trained in engineering so they can become fully useful in responsible positions. If this is not done, there will be a personnel turnover that can slow the program seriously, for there will be other positions in consulting firms and industry, perhaps even more attractive, to which these men can go.

So our highway departments ought to put as much thought into a program for developing their young engineers as on any other phase of the work. It will pay big dividends; it is the young men who, so often, not knowing it can't be done and being full of irreverence for traditions, find the better way, the shorter cut and the common-sense solution.

### Research vs Refinement and Standardization

**M**ANY of the operations performed in the daily job of maintaining streets, collecting refuse, operating sewerage and water systems and treatment plants need study and review. However, not often does such work fall into the category of research. More often it is matter of refinement and standardization, accompanied by development of clear and sound operating procedures.

Many sources exist from which funds can be sought for basic research; but such is not the case for study of most city and county operating and maintenance problems. The main contributions in this field of work have come from committees of our leading technical and professional societies. They have done much, but the demands in this field are great and present resources are very limited. Research funds spent for this sort

of work would pay big dividends in better and more economical operation of public works facilities. A broader and more understanding interpretation of what research is and what it can do in this field would contribute greatly to the improvement of public works economies and services.

### Federal Help for Stream Pollution Control

**A** SIGNIFICANT STEP has been taken in authorizing Federal Aid for design and construction of badly needed waste disposal plants. This legislation, opposed by some prominent engineers as likely to delay ultimately the progress of sewage treatment plant construction, is a forward step in our opinion. Generally we believe in home rule and taking care of our own problems without a Federal handout. In this case, however, the omissions of the past have been so great that catching up without a shot in the arm, is difficult. No doubt it will be difficult, even with Federal help; but the work to be done is so pressing that nothing should be omitted that might help.

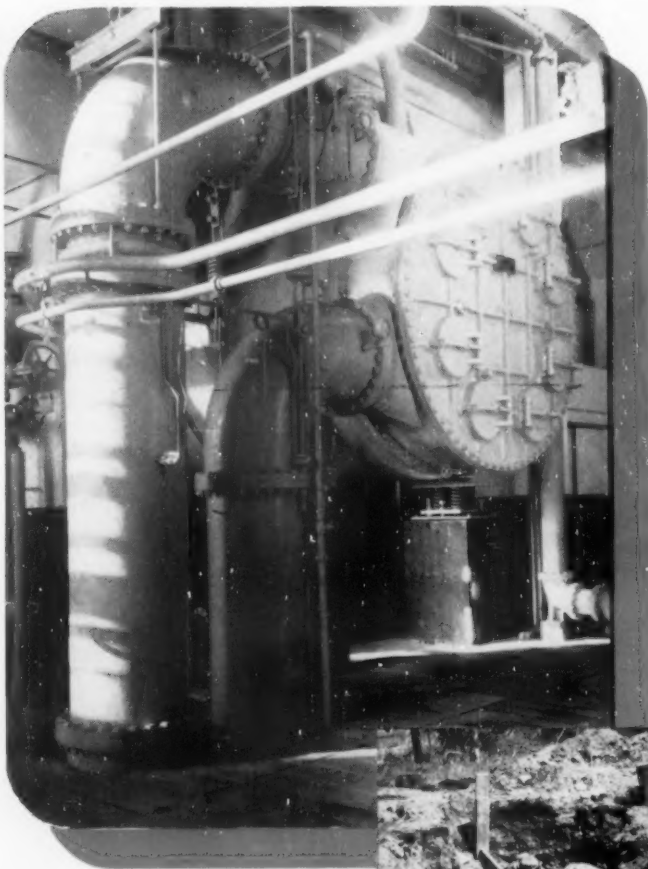
We have long felt that a state-wide water and sewer authority, with the power to build and lease to local communities needed water and sewer systems and treatment plants, would be most useful, while supplying a financially solvent approach to an urgent problem. This could be the next step if Federal Aid is inadequate or ineffective.

### Bigger Jobs for Consulting Engineers To Do

**T**URNPIKES, toll roads and thruways have been largely responsible for getting more consulting engineers into the highway field. The rigid time schedule set for the completion of these highway projects precluded reliance on the usual very limited engineering staff of the highway organizations. The turn to consultants was sound common sense and a logical extension of their use on cantonment construction during the war.

With the big highway construction program coming up, the nation is fortunate in having skilled consultants, experienced in designing and constructing highways. Maximum utilization must be made of their skills and facilities if the highway program is to be carried through to completion on schedule.

# build it to last with



Cast iron flanged pipe and valves on steam condenser in Louisiana oil refinery.

Installing 4,000 feet of 30" cast iron pipe for sewer force main in Petersburg, Virginia.



When an installation should be as permanent as men and materials can make it, rely on rugged, long-lived cast iron pipe. Its uses are many — a few are shown on these pages. Yes, you build it to last with cast iron. Today, *modernized* cast iron pipe, centrifugally cast and quality controlled, is even tougher, stronger and more durable than the pipe our industry made a century ago. Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Illinois.



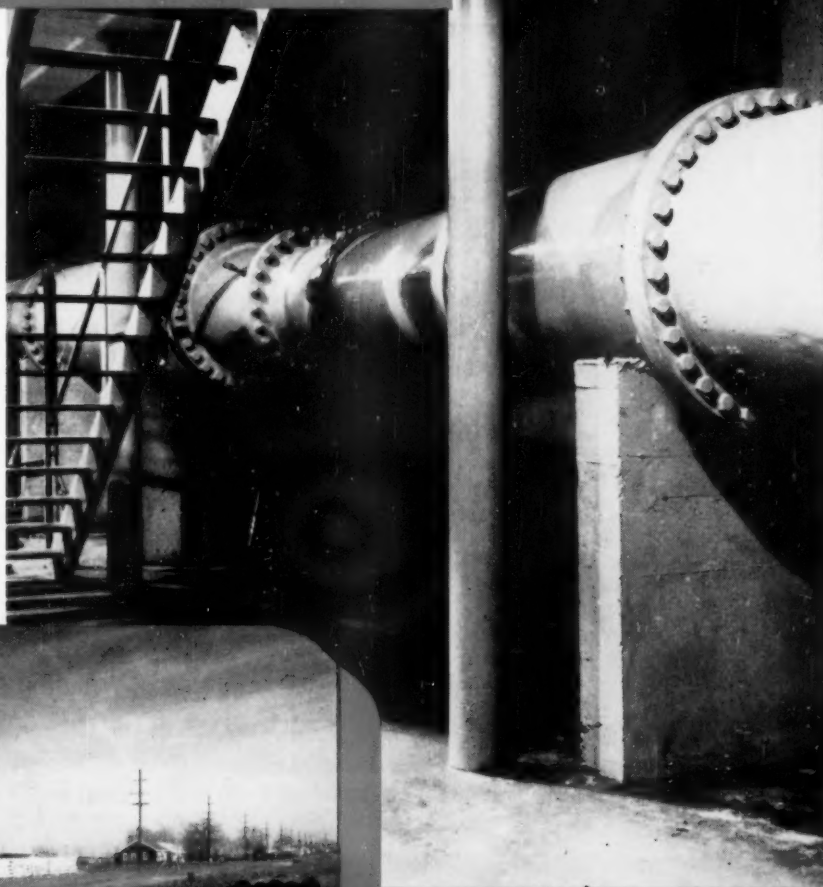
The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.



Installation of 36" mechanical ball joint cast iron pipe for Missouri River intake lines of St. Louis County Water Co.

## CAST IRON PIPE

# cast iron pipe



Cast iron 36" discharge line installed in South Essex Sewerage District Pumping Station, South Essex, Mass.



8,000 feet of 16" mechanical joint cast iron pipe for feeder gas main in Forest View Subdivision, Chicago, Ill.

## **SERVES FOR CENTURIES...**



# Consolidated Edison-



On the job at night. The 1956 Ford F-600 shown gives you a choice of 3 Short Stroke V-8 engines

and a 133-h.p. Short Stroke Six. Front axle capacity 4,600 lbs., rear axle capacity 15,000 lbs.



On instant call. These three 1956 F-350 express models have doghouse-type shelters for transporting men and equipment. Platform is only 2½ feet off ground for easy loading. Max. GVW 8,000 lbs.



Answering an emergency repair call. Here an F-600 with an all-purpose non-dump body is being unloaded on the job. Maximum GVW 19,500 lbs. Lifeguard steering wheel and door latches standard.

## Big Fleet Owners Buy More FORD

# - 35 Years with FORD

## FORD TRUCKS Last Longer . . . Cost Less!

The Consolidated Edison Company of New York generates power that moves trains, runs factories and serves millions of homes. For 35 years Ford trucks have played an important part in the transportation department of this company. Today the Consolidated Edison fleet has 183 Fords, from light-duty F-250 express models to heavy-duty F-600's.

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For *your* operation it will pay you to look at Ford trucks. Ford trucks cost less . . . Short Stroke engine design for low oil and gas consumption . . . Ford's stronger chassis for longer life . . . and Ford's high resale value. So — from Pickups to 65,000-lb. GCW BIG JOBS, the big fleets are going Ford. See your Ford Dealer for the "cost less" story.

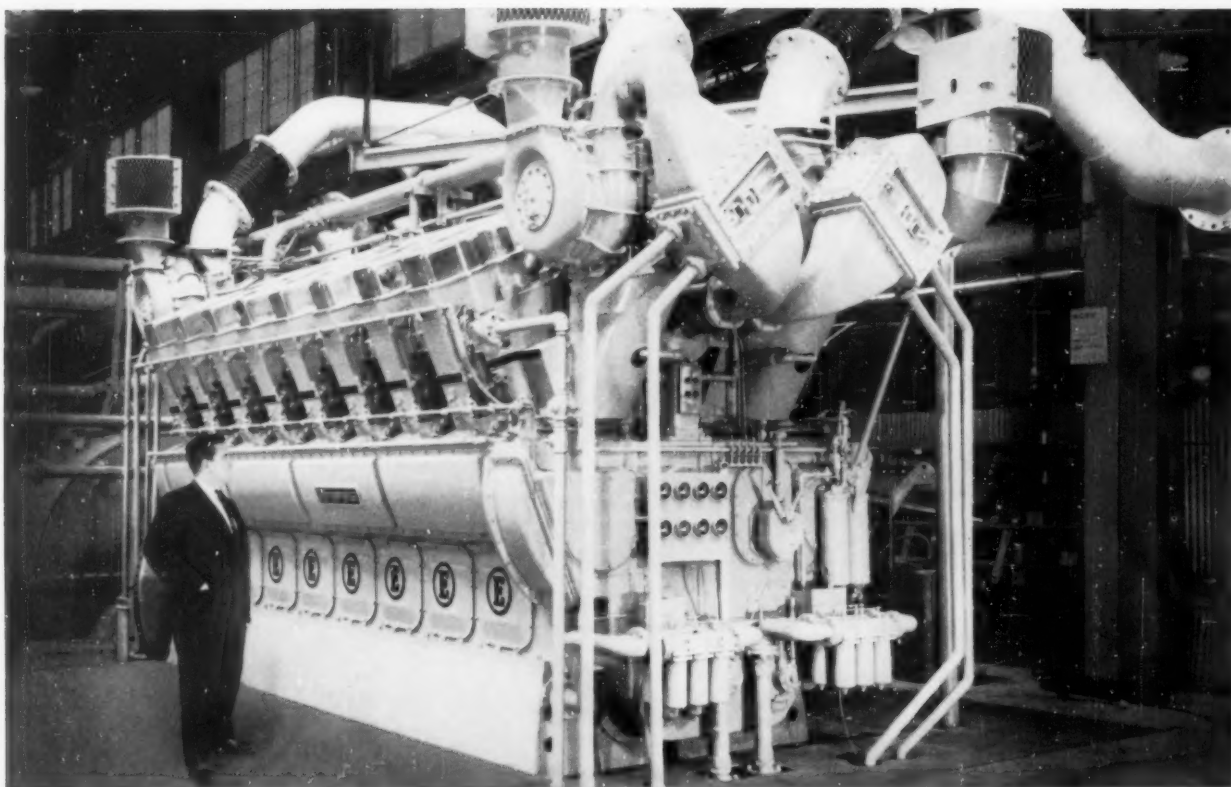


**Starting out for on-the-spot repairs.** F-350 truck with special maintenance equipment for emergency repairs. For power—either the 133-h.p. Six or the 167-h.p. V-8. Both Short Stroke design.



**Checking operation.** Here equipment is being checked by Consolidated Edison maintenance men. This Ford F-350 with Vanette body has a 130-inch wheelbase. Fordomatic Drive available on all light-duty models.

## TRUCKS than Any Other Make !



New 7,700 HP Enterprise RV is 20% shorter, 30% less weight than conventional 16-cylinder diesels of equal power.



## Enterprise announces the new 16-cylinder RV diesel —World's smallest 7,700 HP engine

*"It is a pleasure to present this Enterprise engine—the newest in our line of dependable diesels. The many features and economies of the Enterprise RV make it extremely attractive to users of high horsepower engines—both marine and stationary."*

Arthur W. Ostrander, General Sales Manager

Here at last is a turbocharged V-type, heavy-duty engine specifically developed to produce more horsepower in a smaller unit—dependably and continuously.

For marine installations this means more payload space, greater tonnage capacity than ever before. For electric power generation in municipal or industrial plants, and as power for pumping oil, gas or water, the reduced costs of foundations, installation, operation and maintenance make the RV even more attractive to engineers and owners.

### Diesel, dual fuel, tri-fuel, spark ignition

The RV can be operated as a diesel, dual fuel, tri-fuel, or spark ignited gas engine. Its low operating costs on diesel fuel can be cut even further when residual fuels are used. This is "workhorse" power at its dependable best. Thousands of continuous, uninterrupted hours without shutdown are characteristic of the RV's slow-speed operation.

Less bulk makes installation easier, servicing simpler. RV maintenance doesn't require major disassembly, either. All working parts are accessible for service from the outside. So overhaul costs are kept low and downtime is reduced to an insignificant factor.

### Vital statistics of Enterprise RV:

**Type:** 4-cycle, 12 or 16 cylinders, 17" bore by 21" stroke

**Rating:** To 7,700 BHP at 400 rpm. Piston speed: 700-1,400 fpm.

**Dimensions:** 26' 4" long, 9' 4" wide, 12' 1" high

**Weight:** (less flywheel) 189,100 lb.

**Fuel:** Diesel, dual fuel, tri-fuel, spark ignited gas

Enterprise welcomes your inquiries. Why not plan now to get the complete story? Call or write today, or use the handy coupon.



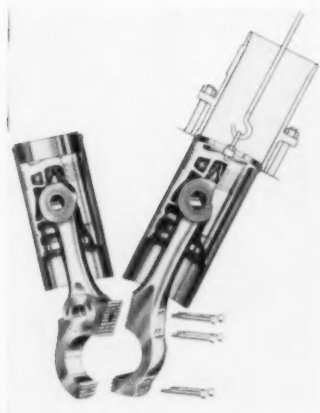
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# How the exclusive Enterprise turbocharged V-block design packs more heavy-duty horsepower into less space, less weight

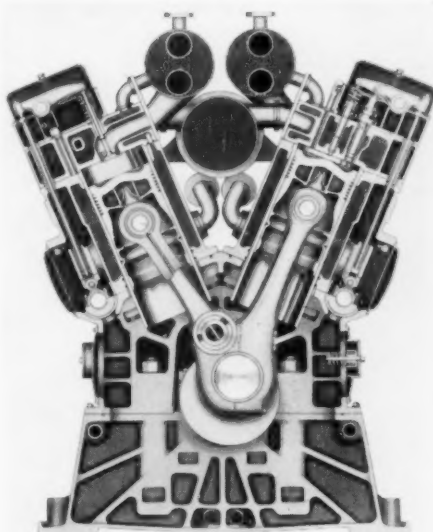


## Connecting rod design cuts engine length 20% ▶

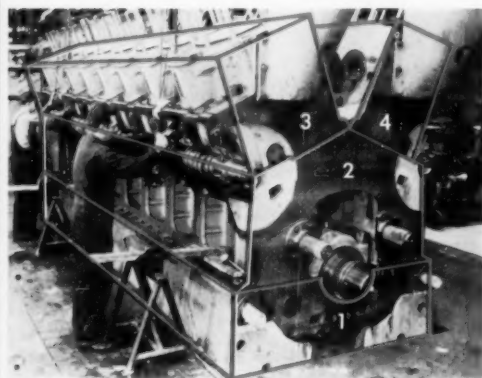
The master-and-link articulated connecting rod permits opposite cylinders in the V to lie in the same plane. Weight-to-horsepower ratio is reduced to only 25 lb. per HP — some 30% less than conventional units.

## Completely accessible — easy to service

The master connecting rod features a rack-tooth joint for quick and easy removal of the entire assembly. Simply release six clamping bolts and withdraw con rod and piston through cylinder liner.



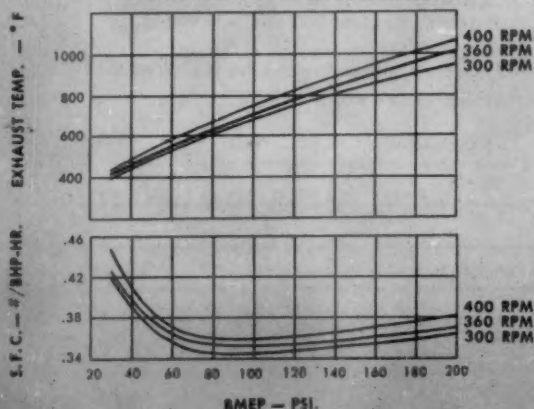
For practicality in manufacture, shipment, installation and maintenance, the RV engine frame is built in four pieces — base (1), crankcase (2) and two identical cylinder blocks (3 & 4), all of quality-controlled cast iron for maximum strength and rigidity.



The high performance standards achieved by the Enterprise RV-16 turbocharged engine are shown on the curve at right. Tests are made under standard conditions on the 10,000 HP capacity hydraulic dynamometer specially built for this new high-horsepower engine series.

## SPECIFIC FUEL CONSUMPTION AND EXHAUST TEMPERATURE VERSUS BRAKE MEAN EFFECTIVE PRESSURE

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☐ Have your representative call.

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# a little **HTH**\* goes a long way in sanitizing new water mains

For a slow, steady source of chlorine, nothing can equal HTH Tablets for convenience, effectiveness and economy.

Let's consider convenience first. All you need do is fasten HTH Tablets to the top of the pipe interior with hot tar or a suitable gasket cement. When the pipe is filled with water, density currents will carry available chlorine to all interior surfaces of the pipe section. Since the tablets stay in place and dissolve slowly, the chlorine is not washed to the far end as the main is filled. Thus complete pipe line sanitation is insured.

As for effectiveness—HTH Tablets, with at least 70% available chlorine, kill bacteria, fungus and algae . . . fast.

And for economy—one tablet of HTH will sanitize up to thirty feet of four-inch diameter pipe! To get complete details about the use of HTH Tablets for new water systems, mail the coupon.

\*HTH is a registered Trademark for high test hypochlorite



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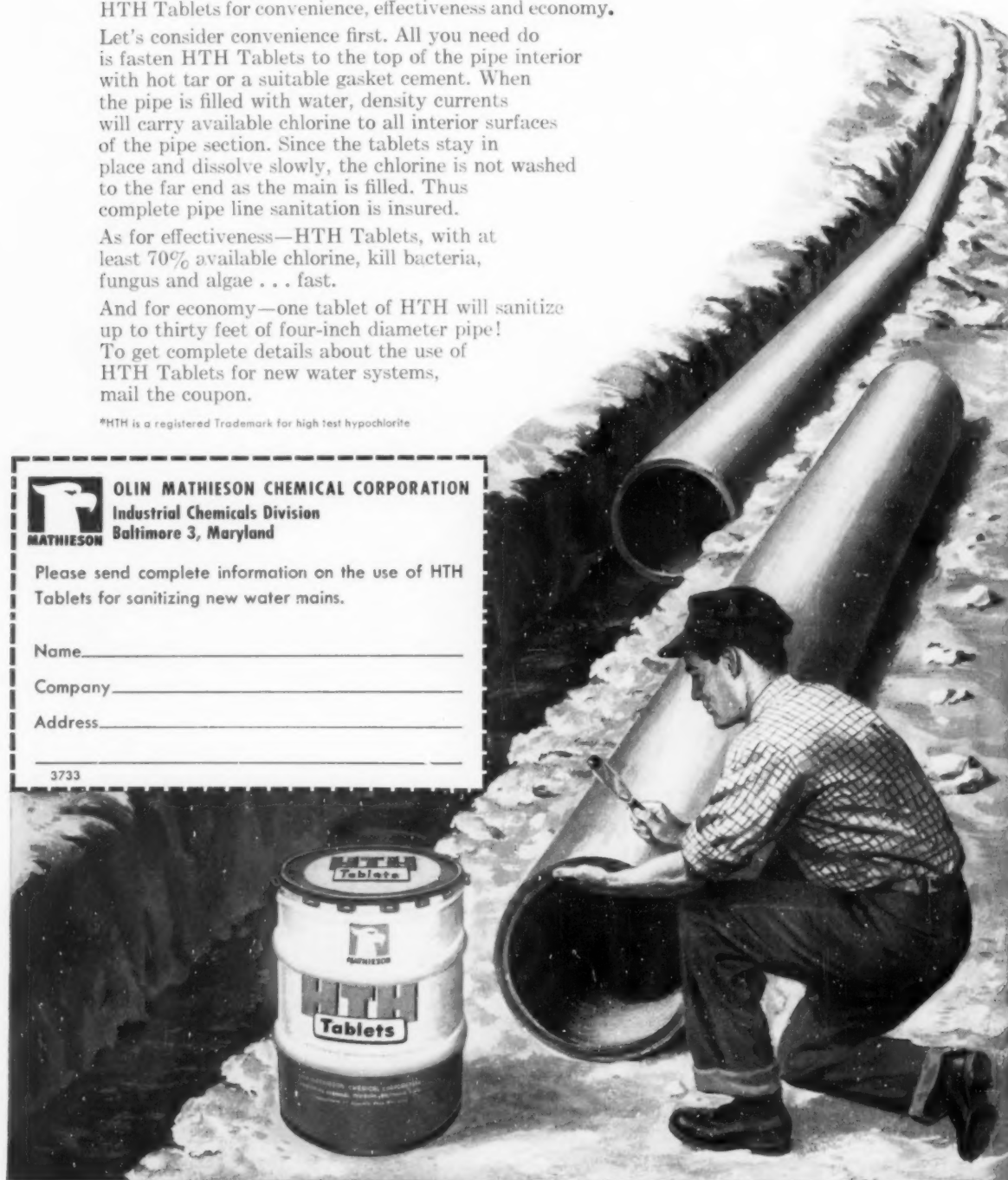
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for Service

### REDUCE YOUR PIPE LINE COSTS 4 IMPORTANT WAYS

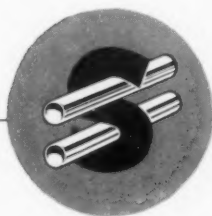
Here's how "Southern" Welded Steel Pipe...combined with "Southern's" *time-table* delivery...can save you money on your pipe line projects:

1. You can specify length, diameter or thickness of welded steel pipe...tailor made to your line.
2. You can order wall thickness to *exact* design requirements...and use "Southern" applied coatings and linings—such as cement mortar, coal tar or asphalt—to protect against corrosion. Overspecification of steel is eliminated...you buy only the steel you need. You save on both initial cost and freight.

3. You can be sure of delivery. "Southern's" accurate delivery time-table coordinates pipe deliveries with your construction schedule...has the right pipe in the right place at the right time!

4. You save on installation. Lighter weight simplifies handling. Long lengths mean fewer joints. "Southern" can supply any desired fittings and field joints...including "Southern's" exclusive PresSeal joint that needs no bolting or welding.

On your next pipe line job, specify "Southern" welded steel pipe for strength...and "Southern Pipe" for service that *saves*.



## Southern Pipe & Casing Co.

DIVISION OF U. S. INDUSTRIES, INC.

MAILING ADDRESS: POST OFFICE BOX C, AZUSA, CALIFORNIA  
TELEPHONES: EDGEWOOD 7-1221, CUMBERLAND 3-5392

# HOLMES-OWEN TRUCK LOADERS

## SAVING Thousands of Dollars

### for MUNICIPAL Users.

#### LOWERS COST OF WINTER JOBS

The City of Lansing, Mich., makes excellent use of Truck Loaders during the snow and ice period to speed up work of clearing streets, removal of snow from intersections, bridges, etc., hauling of stock-pile materials and numerous other jobs that offer Big Savings to the city. Note unit loading salt for distribution during ice control.

LANSING, MICH.



### Cuts JOB COST as much as 50%

Trucks equipped with Holmes-Owen Loaders are today reducing the cost of many jobs as much as 50% and offering users a savings amounting to thousands of dollars annually. The use of this equipment substantially lowers the cost of material handling. It assures faster, more efficient loading and hauling. Saves time, labor and equipment by permitting the truck driver to LOAD, HAUL and DUMP, do light digging, grading and cleaning-up without additional man power or the use of more costly equipment. The Holmes-Owen Loader can be installed on most 1½ to 2 ton trucks. It is hydraulically operated, lifts one-half yard per bucket, loads the average truck in four minutes and can easily do the work of several men. See your dealer or write factory today for literature and prices.

**ERNEST HOLMES COMPANY**  
Chattanooga Tennessee

AMARILLO, TEX.



**SAVES \$27,000 ANNUALLY...** Two Truck Loaders in Amarillo, Texas reduced a street cleaning crew from 15 to 4 men... number of trucks needed from 5 to only 2. Mechanization of this work cut labor cost \$27,000 per year, released 3 trucks for other use.

**CUTS COST ALMOST 50%...** Extensive use of a fleet of self-loading trucks in Birmingham, Ala. reduced cost of maintenance on streets, parks and other public properties almost 50%. Mechanization of such work as spreading anti-skid material on icy streets, removal of dumpings from street sweepers, etc. offers additional savings in time, labor and equipment.

BIRMINGHAM, ALA.





**NO PIPE LAYING DELAYS . . . NO JOINT FAILURES!**



**PROJECT:** New sanitary system, Hickory Township  
Municipal authority, Mercer County, Pa.

**ENGINEERS:** Gannet, Fleming, Corddry & Carpenter,  
Consulting Engineers, Harrisburg, Pa., and R. B.  
McCurdy, Resident Engineer.

**CONTRACTOR:** Holloway Construction Co., Livonia,  
Michigan.

**PIPE:** 15" UNIVERSAL Vitrified Clay Pipe with pre-  
assembled TYLOX Flexible Couplings.

**It's**

## **UNIVERSAL**

### **TYLOX—Jointed Vitrified Clay Pipe**

**LOWER INSTALLATION COST** — Projects using Universal Vitrified Clay Pipe with TYLOX Flexible Couplings go faster, save on costly man hours . . . Pipe and joint are pre-assembled at the factory and shipped to the job site ready for immediate use. Water in the trench doesn't slow up the work, and laid line can be backfilled immediately.

**LONGER SERVICE LIFE** — Universal Vitrified Clay Pipe is non-deteriorating. When coupled with equally durable TYLOX Flexible Couplings, the line is permanently resistant to sewerage and industrial waste acids and alkalis. Write today to arrange for Universal Vitrified Clay Pipe with TYLOX flexible couplings on *your* sewerage and drainage projects.

## **UNIVERSAL SEWER PIPE CORP.**

**UNITED STATES CONCRETE PIPE COMPANY**

#### **PRODUCTS**

Vitrified Clay Pipe with Tylox Flexible Couplings,  
Vitrified Clay Liner Plates, Ship Lap Wall Coping  
and other Clay Products, Concrete Pipe.

#### **SALES OFFICES**

Baltimore, Md.—Halethorpe Branch, Box 7769	Tel. EL-877
Philadelphia, Pa.	Tel. EN-6015
P. O. Box 30, Bristol, Pa.	Tel. ST-8-5571
Cincinnati, Ohio—P. O. Newtown, Ohio, Box 215	Tel. LO-1-7846
Ft. Lauderdale, Fla.—P. O. Box 958	Tel. JA-4-8461

6023

**GENERAL OFFICES • 1500 Union Commerce Bldg. • Cleveland 14, Ohio • Tel. Main 1-5240**

PUBLIC WORKS for October, 1956



IF YOU **HAUL** AND  
**BURN** BRUSH  
YOU'RE SPENDING TOO  
MUCH **MONEY**  
FOR BRUSH DISPOSAL

The modern, money-saving way is to use an ASPLUNDH CHIPPER. It's *engineered* for low maintenance, for trouble-free service. And there are many *exclusive features* of the ASPLUNDH CHIPPER that can be of real benefit to you.

The whole story of how ASPLUNDH CHIPPERS can help you is told in a booklet, "THE MODERN APPROACH TO THE BRUSH DISPOSAL PROBLEM"



To get your copy of this free, informative booklet, just fill in and mail the coupon below . . . it will pay you to know!



*Demonstration easily arranged at your convenience, without obligation.*

**ASPLUNDH CHIPPER COMPANY**  
505 York Road      Jenkintown, Pa.

Dept. W-2

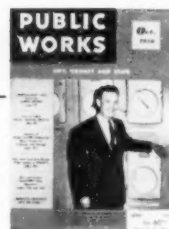
Please send me FREE BOOKLET, *The Modern Approach to the Brush Problem*

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

**BY ACTUAL TEST THE FASTEST CHIPPER MADE**

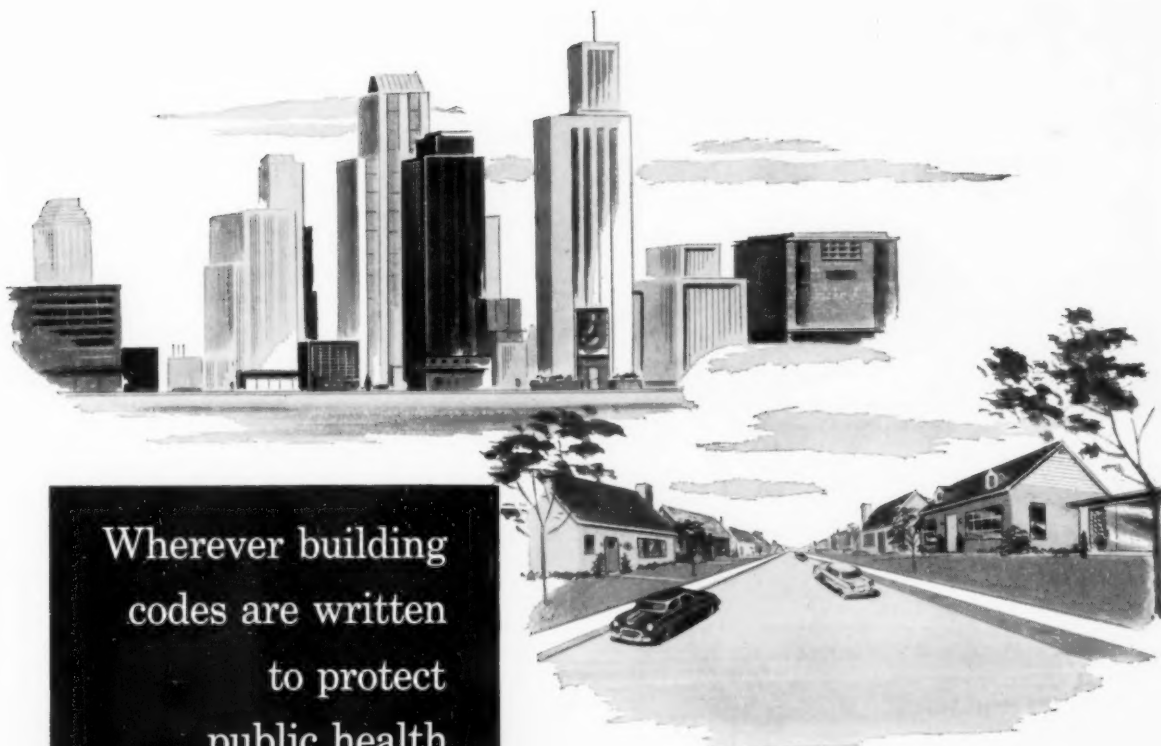


**LEADER IN  
PUBLIC WORKS**

Ray E. Lawrence is Principal Engineer for and member of the firm of Black & Veatch, consulting engineers of Kansas City, Mo. Graduating from the University of Kansas in 1925 with a BSCE degree, he was briefly an assistant engineer for Black & Veatch; then with the Kansas State Board of Health for two years; city engineer of Chanute, Kansas; and from 1933 to 1937 with the Kansas WPA, advancing from Engineer Examiner to State Director. He then rejoined Black & Veatch with whom he has been associated since, except for five years of wartime duty.

Given leave of absence in 1941 for service with the QMC of the Army, Engineering Branch, Water & Sewage Section, he brought order out of chaos and was largely responsible for the fine sanitary engineering program of the QMC and later of the C of E. It was your editor's pleasure to work closely with him during this period and to see at first hand the changes in attitude of the construction organizations.

In 1942 he was called to active duty in his reserve rank of Captain, Corps of Engineers. He served overseas in the ETO, winning a deserved promotion to the rank of Colonel and being awarded the Legion of Merit. Upon release from active duty, he returned to Black & Veatch and, in addition to much other work, has represented them in AEC and Defense Department activities. He is a member of many leading technical societies and of the honorary society Sigma Tau; and a registered professional engineer in Kansas, Missouri and New Mexico. With his family, he lives in his new and delightful house in Kansas City.



Wherever building  
codes are written  
to protect  
public health

# CLAY PIPE IS SPECIFIED

In communities all over the nation, there's a movement to improve and modernize plumbing codes for greater public health protection. It's strictly a local problem, as it should be, and the recommendations of local people carry a lot of weight. That's why you find Vitrified Clay Pipe named as the standard of quality in so many of these codes. Clay Pipe is traditionally the "plumbing code pipe." It is specified to save time and labor on jobs, and to assure public health protection that never wears out. Today, as the Clay Pipe industry produces a new, longer, stronger product, with a variety of root-proof joints, Clay Pipe is more than ever before a time-tested companion to the good workman's skill.



**NATIONAL CLAY PIPE MANUFACTURERS, INC.**  
1820 N. Street, N.W., Washington 6, D. C.

206 Connally Bldg., Atlanta 3, Ga.  
100 N. LaSalle St., Rm. 2100, Chicago 2, Ill.  
703 Ninth & Hill Bldg., Los Angeles 15, Calif.  
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio

## Vitrified

# CLAY



# PIPE

C-656-

**Progress in Public Health - Through Clay Pipe Research**



## Town of West Miami Reports: **M-B PACKER BODY CUTS NUMBER OF TRIPS TO DUMP IN HALF!**

Since purchasing a 20-yd. M-B Packer Body in May, 1955, the Town of West Miami, Fla. has seen refuse collection costs steadily decrease and the number of trips to the dump cut in half. The Town has had substantial savings in time and money, even when the amount of refuse hauled rose sharply soon after the M-B unit hit the route.

### Efficiency of Operation Improves 100%

West Miami has kept a close record of refuse hauling costs. Mr. H. N. Buchner, Town Clerk, reports that a 20-yd. open truck had previously been used for all rubbish pick ups. Cost of this operation skyrocketed as the amount of trash hauled rapidly increased. Town officials contemplated the addition of a second truck and extra crew. Instead, a single M-B Packer with the original 3-man crew was put into service. Efficiency of the entire pick up operation immediately improved 100%! Haul trips to the dump were cut in half and an average \$1.75 was saved for every trip knocked off the old schedule. Overtime was eliminated, with their routes of approximately 500 stops being picked up in 6 to 8 hours' time!



### "Completely Satisfied"

Mr. Buchner noted his satisfaction with the M-B Body by saying, "The Town of West Miami is completely satisfied with the M-B Packer and feels sure that if the need arose, we would purchase another. I would recommend this body to other municipalities."

M-B Packers can solve your collection problems. A demonstration will prove its value —

- ✓ **FAST ON THE ROUTE**
- ✓ **SAFEST COLLECTION UNIT**
- ✓ **EASY ON TRUCKS**
- ✓ **REDUCES OPERATING COSTS**
- ✓ **LOW ORIGINAL COST**

Send us your name and disposal problem — we're anxious to help you.

#### M-B CORPORATION

1611 Wisconsin Ave., New Holstein, Wis.



PACKER BODIES • LINE MARKERS • SWEEPERS • PAINTS AND BEADS

**M-B CORPORATION**

NEW HOLSTEIN, WIS.

MANUFACTURERS OF QUALITY  
MUNICIPAL AND CONSTRUCTION EQUIPMENT SINCE 1907





## The Unit You Will Use Every Hour of Every Day

There is more flexibility in a Ford tractor with a Sherman back-hoe and loader than in any other equipment on the construction site today. You'll use it on more different applications than anything else you own. Trenching for footings, service lines, sewers and drains—digging holes for tanks and catch basins—loading aggregates, levelling, back filling and light stripping—carrying materials and supplies, cleaning up and distributing loose materials—and dozens of other jobs. It's an inexpensive machine you can easily afford for the many odd construction

or maintenance jobs that crop up so consistently.

The two big reasons why you see more Sherman Power Diggers than any other kind are simply these: You get more production from a Sherman and your Ford Tractor Dealer, having sold so many, is equipped and skilled in helping to keep your machine on the job working at peak output without costly downtime.

Now is the time to see your Ford Tractor Dealer for a demonstration of this dependable, high production back-hoe; or, write for Bulletin No. 543.

See the Sherman  
Power Digger soon  
at your local  
**FORD TRACTOR DEALER**



\*Designed, Engineered and  
Manufactured jointly by  
Sherman Products, Inc.,  
Royal Oak, Michigan.  
Wain-Roy Corporation,  
Hubbardston, Mass.

© 1956 Sherman Products, Inc.



## In Pasco, Washington, too—Clevelands® do the digging



**DISTRIBUTION SYSTEMS** in Pasco and Kenewick, Washington, are being constructed for Cascade Natural Gas Company by A. J. Curtis Construction Company of Casper, Wyoming. Even in alleys and similar narrow rights of way, such as the 4-inch main installation shown, Curtis, cashing in on the compactness and maneuverability of his Cleveland trenchers, is averaging 1,650 feet of trench per 6-hour day.

Crowded cramped quarters or open fields, rocky soils or easy digging—Cleveland's original compactness, maneuverability, exclusive wide range of power and speed combinations and recognized quality construction are the reasons they dig *more trench . . . in more places . . . at less cost*. That's why you'll find Clevelands leading the way on gas work in the Pacific Northwest—as they have *everywhere* for over 30 years.

### THE CLEVELAND TRENCHER CO.

20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO



## LETTERS TO THE EDITOR

### A LETTER FROM JAPAN

Greetings from Japan! I am on a 3-month W. H. O. assignment, the first part of which is serving as a consultant to the Japanese Ministry of Health to recommend national legislation, a program, policies of administration, etc., for national stream pollution control. There are no such laws at present. I am traveling all over Japan observing conditions in streams, industries of various types, cities, etc., to learn the problems. Needless to say it is a marvelous experience, both intensely interesting and profitable because of the expansion of Japanese industry and limited water resources.

It has been interesting to note the high regard for sanitary engineers and the general excellence of their operating personnel at both water and sewage treatment plants. Have also had some very interesting discussions with sanitary engineers who served in the Japanese army—surprisingly we all had many technical and administrative problems in common. The new Japanese water treatment and sewage treatment plants are especially fine structures, well designed, equipped and operated; but there remains many problems in this country especially housing. It is rare to see any evidence whatever of war damage, due apparently to their industriousness, for construction goes on day and night. Another sight novel to Americans, is that on construction jobs everyone is working; and an abundance of labor is available. From Japan, I go to Formosa to serve as a consultant to the Director of Reconstruction on Water and Sewerage projects; then to North Borneo via Hongkong and Manila to inspect several sewerage projects under construction as a result of my visit two years ago; then several weeks in Sarawak as a consultant on a sewerage project for the capital city of Kuching. I re-

(More on page 26)

# Here's the Equipment That Really Stretches Maintenance Budgets!



## CONCRETE GUNNING EQUIPMENT

For maximum efficiency, speed and economy, public works officials are turning to the new AIRPLACO Portable Concrete Gunning Rig. From simple road, curb and street repairs to major concrete reconstruction projects on bridges, docks, sewers, reservoirs and many other structures, you can do the job faster and at far less cost with the AIRPLACO Rig.

The AIRPLACO Rig consists of the SAND-LOADER for rapid loading of sand; the MIX-ELVATOR\* for automatic proportioning, continuous mixing, elevating and screening; and either the NUCRETOR\* or BONDACITOR\* for the actual application of the concrete. (The NUCRETOR or BONDACITOR is available separately.) The entire unit can be towed easily by your pick-up or compressor truck. No set up time required.

Investigate AIRPLACO concrete gunning equipment now.

\*Registered Trade Names

Whatever Your Specific Requirements,  
There's an **AIRPLACO** Concrete Gun  
to Do the Job

AIRPLACO concrete gunning equipment is available in a wide range of sizes to fit your production and job requirements from 1/2 to 7 cubic yards of aggregate per hour, and using air compressors with 75 to 600 CFM capacity.



**FREE  
Complete Line  
Catalog!**

See your AIRPLACO distributor or write today for your complimentary catalog. Here are the answers to many of your questions about AIRPLACO equipment and job applications.



**AIR PLACEMENT  
EQUIPMENT CO.**

1013 WEST 24TH ST. • KANSAS CITY 8, MO.

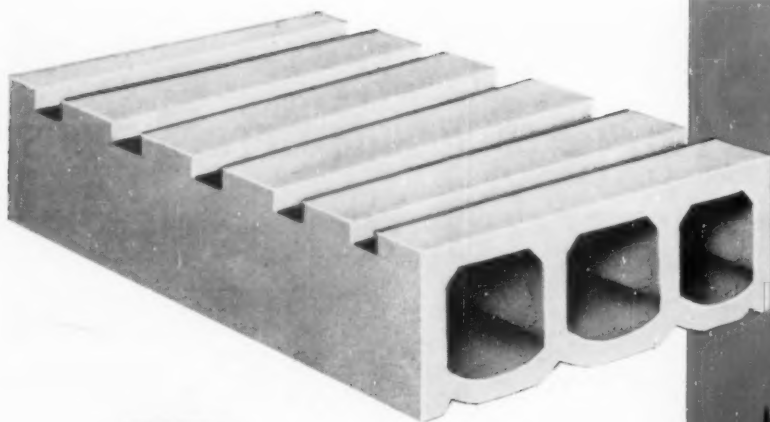
MANUFACTURERS OF ADVANCED DESIGN CONCRETE GUNNING, MIXING AND PUMPING EQUIPMENT



DOCK and HARBOR REPAIRS

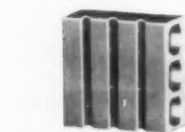


SEWER RESTORATION



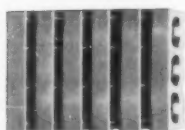
**FASTER FILTER  
DRAINAGE . . .**

**LOWER  
INSTALLATION  
COSTS**



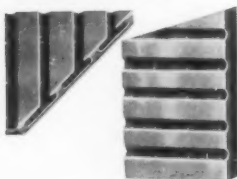
### 3 BIG DUCTS

for faster runoff. Their smooth, clog-proof interiors speed up drainage.



### 5 LATERAL SLOTS

provide extra air space for improved aeration and filter floor ventilation.



### DESIGN VERSATILITY

simplifies your installation problems—special lengths, shapes, fittings.



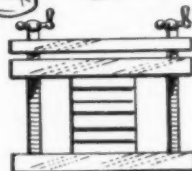
### LIGHT WEIGHT

makes handling and installation easy. One man can lift and put in place.



### CORROSION RESISTANCE

assures permanence. Unaffected by acids, alkalis, and sewage gases.



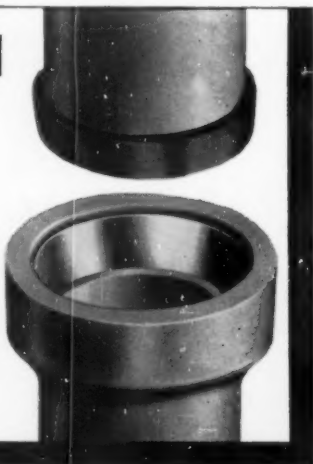
### GREAT STRENGTH

resists damage when stone is placed. Made of selected, shale clay and vitrified.

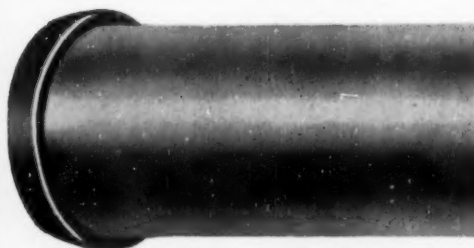


## New CANNELTON Exclusive! *Plastic* JIFFY-JOINTS

The bright red thermoplastic ring on the spigot end can't soften or deform in storage, even under scorching sun. Paint the bituminous casting inside the bell with solvent and push the spigot into place—the long-lasting plastic joint seals even tighter than conventional joints!



## CANNELTON and TEX-VIT CLAY PIPE . . . NOW IN LONGER LENGTHS . . . with JIFFY-JOINTS®!



**CANNELTON**

**SEWER PIPE COMPANY**  
CANNELTON, INDIANA



# TRANSLOT<sup>®</sup> ≡ FILTER BLOCK by TEX-VIT<sup>®</sup> and CANNELTON



Translot is guaranteed for 50 years! Each block is built to rigid quality standards—and tested at a compressive strength of 500 lbs. per square inch. It's made of chemically inert clay and vitrified, so it never wears out—and the basic block size of 11 3/4" by 18" is compact and easy to handle.

In addition to assured permanence and easy installation, you get improved

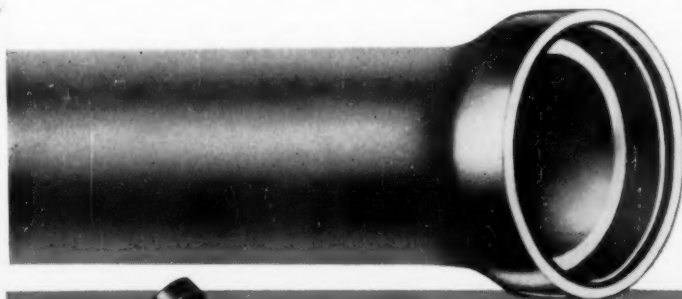
performance. Good aeration and fast drainage are the two key factors in any filter plant, and Translot's three big drainage ducts and five ventilation slots give you *maximum* efficiency. Write for literature.



New Joint-Saver<sup>®</sup> Clay Pipe, available in three and four foot lengths, speeds flow by reducing the number of joints and thereby cutting interior turbulence. Extra-long Joint-Saver Pipe also saves labor time and jointing materials in installation.

Joint-Saver Clay Pipe is available with pre-cast bituminous Jiffy-Joints, as well as conventional bell-and-spigot ends. Jiffy-Joint Clay Pipe assures a tight seal, with

greater protection against infiltration. Installation is easy and fast—just paint the built-in bituminous rings with solvent and push the pipe together . . . the jointing surfaces weld together chemically.

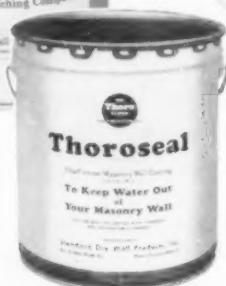


**TEXAS VITRIFIED PIPE COMPANY**  
*Serving the  
Great Southwest*

**MINERAL WELLS, TEXAS**

## Pier structure gets *New, Longer Life* with **THORITE** Nonshrink patch, **THOROSEAL** masonry sealer coat

Structural concrete suffers deterioration from the elements. If these surfaces had been protected from water penetration, freeze and thaw cycle would not have caused these maintenance problems. Workmen are shown cutting out defective areas, patching with **THORITE** without necessity of forming and then sealing surface with **THOROSEAL**.



**THORITE** 20-minute nonshrink, nonslump patching mortar has received international acceptance by men who know, Architect, Engineer and Contractor. **THORITE** requires no forming, permitting immediate completion of job.

*"How to do it"*

GET OUR 16  
PAGE BROCHURE



**STANDARD DRY WALL PRODUCTS, INC.**  
NEW EAGLE, PENNA.      CENTERVILLE, IND.

turn home by way of Malaya, Siam, India, Egypt, Italy, Switzerland and France. Incidentally I was married in June and my wife is with me. I expect to be back on the job in Illinois the last week of October and hope to see you at the APHA. Enroute Beppu, Japan, from Kobe aboard Kogane Maru.

C. W. Klassen

Chief Sanitary Engineer,  
State Department of Health,  
Illinois.

## **SANITATION IN THE SOUTHWEST**

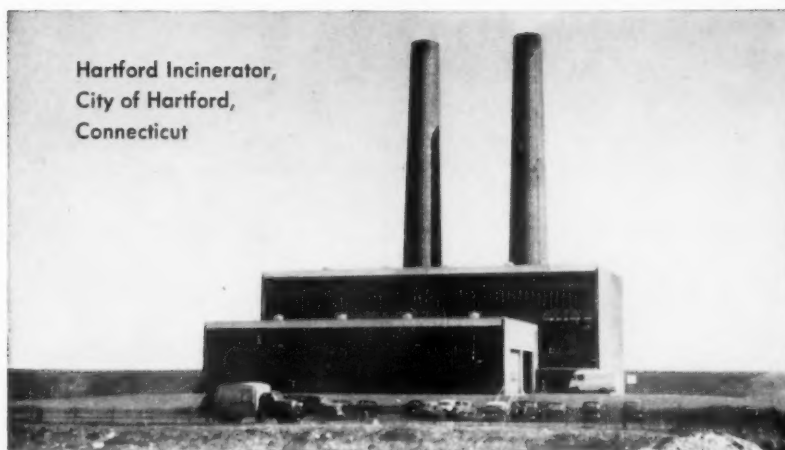
We now have two full-blown landfills going, an annual item of \$85,000 in the County budget. We handle garbage and trash brought in by the public and by franchised garbage removal companies and have begun to take refuse from the cities of Phoenix and Tempe, whose fills are beginning to give out.

You may recall my experiment involving the disposal of septic tank and seepage pit pumpings in the landfill. This has worked out exceedingly well, in a nuisance-free manner. The pumpers all operate under permit in accordance with our regulations. These fellows used to dump their precious cargoes at will about the desert, but now for 50¢ a load, which varies from 750 gallons upward, use the landfill. The pumper buys a book of tickets, usually \$10 worth, and gives up a ticket at the landfill for each unloading. Under Arizona conditions the dry working face of the landfill accepts these noxious liquids hungrily and within minutes all evidence of the sewage is gone. Speedy cover always puts the coup-de-grace to the operation.

We have other problems. Swimming pools are as common as flapjacks. Local contractors have a strong aversion to poured concrete pools, scum gutters, and a few other familiar items. Gadgety chlorinators consisting of floats carrying chlorinous pellets are used in pools commonly, while plastic pipe of doubtful ancestry is carefully embedded in concrete for eternity or for the first major leak.

Flavor the above with a few problems involving food and food products, the milk shed, labor camps for itinerant agricultural workers and that master seasoning of them all, subdivisions, and you have a sample of Maricopa County, Arizona, conditions.

J. J. Weinstein  
Sanitary Engineer  
Maricopa Co.  
Arizona



Hartford Incinerator,  
City of Hartford,  
Connecticut

## Modern Hartford disposal plant uses **FITCHBURG CHIPPER**

Hartford's new municipal incinerator is used to dispose of more than 400,000 pounds of waste every day. The large picture above shows this efficient, attractive plant—one of the most modern in the nation.

An important part of Hartford's up-to-date disposal program is their portable Fitchburg Chipper, which cleans up disposal jobs the incinerator cannot handle, and goes out on location for road use.

### Hartford had these problems:

- Banana Stalk Disposal • Brush Disposal on New Roads
- Christmas Tree Disposal • Road Clearance from Storm Damage

### How a Fitchburg Chipper solves these problems:

Joseph J. Coffey, Superintendent of the Hartford Incinerator, tells you in his own words how Hartford solves these problems: **BANANA STALKS:** "We chip 2 to 4 tons of banana stalks each week. These stalks will not burn regardless of heat in the furnaces, and we had to dump them until the Fitchburg Chipper went on duty." **CHRISTMAS TREES:** "During the post-Christmas season we receive many Christmas trees which we can now get rid of without the trouble of watching for burnt-down spike-like stubs which cause much trouble with the incinerator equipment."

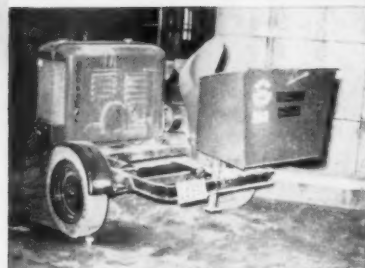
**BRUSH DISPOSAL:** "Our Highway Division has used our Fitchburg Chipper to clean up the brush and branches along newly developed road areas. By chipping brush, the city saves in use of both manpower and trucking costs." **ROAD CLEARANCE:** "If we get hit again by hurricanes or bad wind storms, we now have an excellent piece of equipment that will enable us to readily open up the streets for emergency traffic by reducing the fallen branches to chips."

As to maintenance, Mr. Coffey says: "Our Fitchburg Chipper will pay for itself in a very short time. Maintenance, so far, is just keeping it supplied with gasoline and fully lubricated. It is easy to handle, easy to store, and very easy to use."

### Get the facts!

Mail coupon for big, **FREE**, colorful booklet. Specifications, operating data, explanation of exclusive Fitchburg Safety Spring, actual letters from users.

**FITCHBURG ENGINEERING CORPORATION**



(1) Hartford's Fitchburg Chipper



(2) Fitchburg Chipper in action

## Read what leading Fitchburg users say

### LINE CLEARANCE

*The Shade Tree Service Company, Webster Groves, Mo.:* "Our figures show that production has been increased by a good 25% with the use of the Fitchburg Chipper. One man can operate the chipper with ease. He alone can handle as much, and more, brush in the same length of time as could two men loading brush on a platform body."

### POWER COMPANY

*Rockland Light and Power Company, Nyack, N. Y.:* "Our men have been particularly pleased with their Fitchburg Chippers. They are rugged and reliable and the convenience of flexible, yet instant brush disposal has the advantage of promoting good public relations and still gives us efficiency."

Send for  
**FREE BOOKLET**



Fitchburg Engineering Corporation  
Fitchburg, Mass., Dept. PW-106

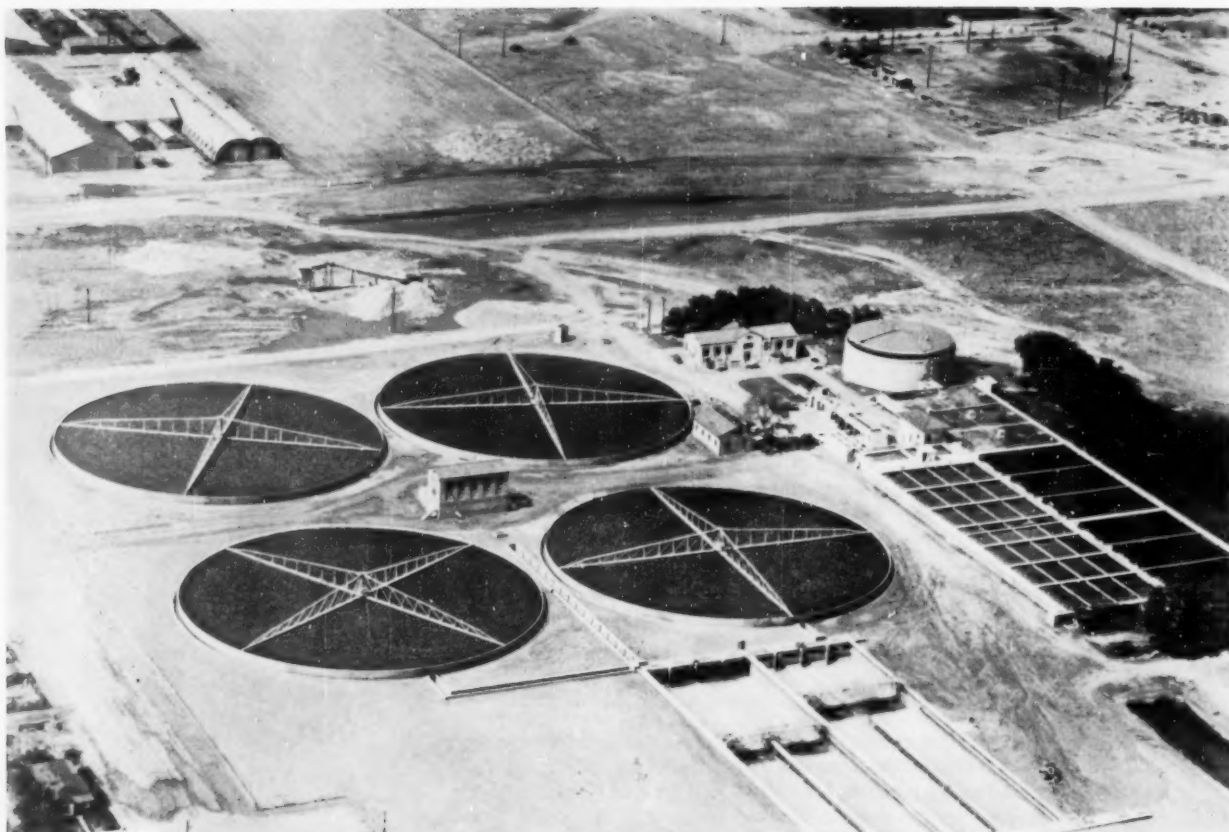
Send my Free Chipper Booklet.

Name

(Position or Company)

Address

City  State



Showing secondary treatment added at El Paso sewage treatment plant. The biofiltration flowsheet is employed.

#### **Designed by**

Ashley G. Classen and Associates,  
Consulting Engineers,  
El Paso, Texas.

#### **Construction by**

Robert E. McKee  
General Contractor,  
El Paso, Texas

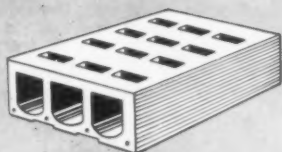
#### **Equipment by**

Dorrco: Distributors 220' in diameter with each capable of handling a maximum flow of 13,900 gpm at 2.75' head. Two Dorco Manorakes are each in a basin 67' 10½" wide by 245' long. 150,933 sq. ft. of TFFI underdrain installed.

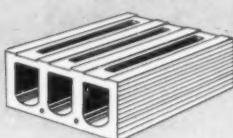
#### **TFFI SPECIFICATIONS**

For underdrains are contained in pages 37 and 38 of the TRICKLING FILTER HANDBOOK, under "Standard Specifications for Vitirified Clay Filter Blocks for Tricking Filters." Available from any TFFI member.

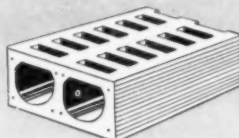
## **TRICKLING FILTER**



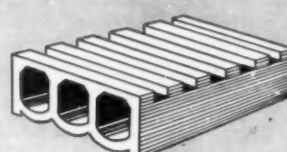
**DICKEY**  
W. S. Dickey Clay Mfg. Co.  
902 Walnut St.  
Kansas City 6, Mo.



**POMONA**  
Pomona Terra-Cotta Co.  
Pomona, N. Car.

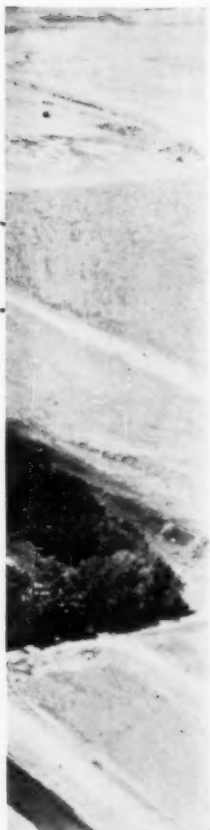


**ARMCRE**  
Ayer-McCord Clay Co., Inc.  
Brazil, Ind.



**TRANSLOT**  
Texas Vitrified Pipe Co.  
Mineral Wells, Texas.





# TFFI

## UNDERDRAINS

*are used in*

### Trickling Filters

*at*

## EL PASO, TEXAS

And mark the steadily mounting acceptance of trickling filters in sewage treatment. With urban growth what it is everywhere, trickling filters with TFFI Specification underdrain blocks are the best guarantees of efficiency and flexibility for larger loads in a future which may be nearer than many cities think.

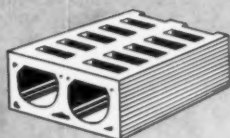
## Trickling Filters are Best

### Because

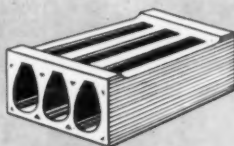
Advantages of flexibility include the fact that the essentials are the same for low rate or high rate filters, for large volume or small. A basic, properly designed trickling plant such as El Paso's is capable of meeting all requirements—present and

future — within foreseeable limits. Plus these other desirable features: ability to handle overloads, expansion, simplicity and reliability of operation, long life, low costs, durability and good results.

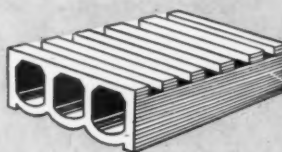
## FLOOR INSTITUTE



**BOSCO**  
Bowerston Shale Co.  
Bowerston, Ohio



**NATCO**  
Natco Corporation  
327 Fifth Ave.  
Pittsburgh 22, Pa.



**TRANSLOT**  
Cannelton Sewer Pipe Co.  
Cannelton, Ind.



Symbol of  
good treatment

# BROS ROTARY SNOW PLOW LOADS 5-YARD TRUCK IN 30 SECONDS; CASTS 50 FEET IN ANY DIRECTION

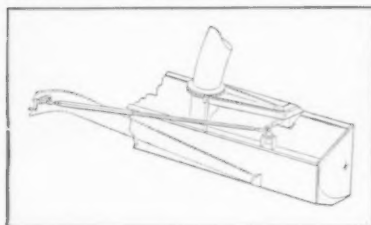
## MOUNTS ON INDUSTRIAL TYPE TRACTOR LOADERS, GRADERS AND JEEPS

**SNOW BELT, U.S.A.** The big news in this part of the country is single lane loading of windrowed snow with the Bros Series "A" Sno-Flyer. This powerful rotary snow plow loads a 5-yard truck in less than 30 seconds — or where convenient — tosses tons of snow up to 50 feet away.

That's really getting snow off the streets fast and it's done without snarling traffic; the Sno-Flyer's casting chute is rotated directly forward to load truck straddling windrowed snow. The whole operation is performed up to 10 times faster than by bucket loader and without jockeying back and forth for loading position.

## MOUNTS ON MOST INDUSTRIAL-TYPE TRACTORS

The Bros Series "A" mounts on almost all front-end hydraulic bucket loader attachments with 1,000 lb. capacity. It is easily installed by the same bucket pin connections. Hydraulic lift arms permit plow to knock down drifts up to 10 feet high, chewing them down layer by layer. No other comparable rotary can work on deep drifts so effectively.



## BALL BEARING MOUNTED CASTING CHUTE

Ball bearing mounted casting chute is turned from the tractor cab, providing you with directional control of snow ejection through 180 degree arc. Positive control for "spot casting" in confined areas.

The Series "A" Sno-Flyer's segmented "finger joint" chute capper permits you to adjust height of snow stream, just like crooking your finger. And an optional longer chute which is interchangeable with capper is available for loading trucks.

## BROS SLIT-SPIRAL ROTOR-FEED RAKE

A close look at the Series "A" slit-spiral rotor-feed rake shows you the world famous Bros Sno-Flyer design. It rapidly gorges wet, heavy and chunky snow as well as fresh fallen snow; small stones and street debris do not hamper its operation.

The non-clogging rotor-rake feeds the snow to casting chute, as rapidly as

moldboard area fills, hurling it up and out.

Rotor's cutting height is 30 inches. Oscillating type runners provide ground contact.

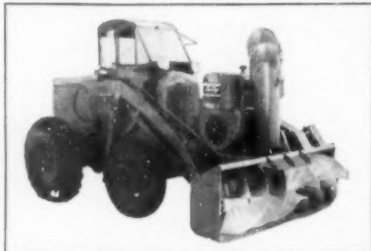


The unique knifing action of the slits prevents packing of snow around the rotor hub; snow is moved up to 7 tons per minute in a constant, even discharge.

Three plowing widths are available: 4' 4", 5' 6", and 6' 6". With only a 30 hp engine, the Series "A" performs the work of much bigger units and with equal efficiency.

## MOUNTS ON OTHER TYPES OF EQUIPMENT

Besides mounting on most industrial type tractors, the Bros Series "A" Sno-Flyer mounts on popular makes of self-contained front-end loaders. Such equip-



ment is thus kept on a year 'round working schedule.

Road patrol graders and crawler tractors, too, use the powerful Bros Series



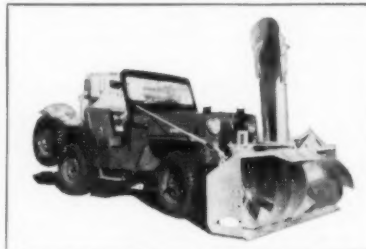
Heavy, wet snow is hurled by the ton into waiting line of trucks on Luverne, Minnesota's Main Street. Normal traffic is quickly resumed after heavy March snow fall. Bros Series "A" is mounted on Ford Major tractor with Wagner loader. Dozens of snow belt cities report enthusiastic approval of this plow's great performance.

"A". Hydraulic arms for scarifier on grader are used to attach snow plow unit.



## FOR 4-WHEEL DRIVE JEEPS

A special undercarriage push frame and hydraulic lift are used to mount the Series "A" on 4-wheel drive jeeps. Plow's



engine is placed in the rear for best weight distribution. This unit is sold nationally through Jeep distributors.

You'll find the Bros Series "A" Sno-Flyer the best operational plow for solving municipal snow removal problems. It is especially effective in cramped working areas. Get complete information and a demonstration from your nearest Bros distributor. Or write: The Wm. Bros Boiler & Mfg. Co., 1057 Tenth Ave. S.E., Minneapolis 14, Minnesota.



**BROS**



## CAST TO LAST 100 YEARS

The name "CLOW" cast on the face of cast iron pipe is your guarantee of high quality. This distinctive "autograph" marks the precise, modern production methods and the advanced, exacting control of metallurgical quality employed by Clow to assure you the finest cast iron pipe.

Four generations of waterworks operators and municipal officials have looked to Clow for high quality and good service. Clow cast iron pipe exceeds the physical requirements of all currently approved specifications. We would welcome the opportunity to serve you.

### JAMES B. CLOW & SONS

INC.

201-299 North Talman Avenue • Chicago 80, Illinois

Subsidiaries:

Eddy Valve Company, Waterford, New York

Iowa Valve Company, Oskaloosa, Iowa

# FREE

# EQUIPMENT DATA to Help Your PUBLIC WORKS PROGRAM

## NEW LISTINGS

### Agent For Improving Adhesion Between Old and New Concrete

530. Thorobond liquid bonding agent for improving adhesion of new concrete to old concrete walls, floors and ceilings is described in literature available from Standard Dry Wall Products, Inc., New Eagle, Pa. Check the reply card for information on typical uses and methods of application.

### Bailey Meters And Controls

531. Over one hundred measuring, transmitting, receiving, recording, and indicating instruments and control components for power and process applications are described in an 8-page Bulletin No. G15-1. Write Bailey Meter Co., 1050 Ivanhoe Road, Cleveland 10, Ohio, or check the reply card for your copy.

### Choosing Your Equipment and Maintaining Its Efficiency

534. Bulldozers, tractors, scrapers and motor graders are fully described in a catalog from Allis-Chalmers Mfg. Co., Box 512, Milwaukee 1, Wisc. Covered are choosing your equipment, maintaining its efficiency and handling your jobs. Check the reply card.

### Valve Check Charts For Selecting the Proper Valve

535. Two excellent valve check charts, one for bronze globe valves and one for iron-body valves are available from The Kennedy Valve Mfg. Co., East Water St., Elmira, N. Y. Valve users may make an evaluated selection of the right valve to use in solving a particular valve problem. Check the reply card for your standard calendar size charts.

### The Robot System For Skip-Line Paint Striping

536. The electronic robot marking system can operate on any line markers that have automatic spray guns. It can mechanically reproduce the old skip line markings and no passing lines within  $\frac{1}{4}$ " at any speed from one to 20 mph. Full information from Universal Mfg. & Sales Co., 424 West Redondo Beach Blvd., Gardena, Calif.

### Gas Analyzer-Recorder For Combustion Products

539. Instruments for the analysis of CO<sub>2</sub>, H<sub>2</sub>, CO and CH<sub>4</sub> are fully described in literature available from Cambridge Instrument Co., Inc., 3631 Grand Central Terminal, New York, N. Y. Instruments are used to check tunnels for CO and to check for digester gases. Check the reply card.

### Bulletin Helps Specify A.W.W.A., Gate Valves

547. Double disc gate valves in 2" to 60" sizes are fully described in a 16-page bulletin which gives details on valve parts, design, materials, application of the "O" Ring Seal, operation and operating devices, directions for ordering valves and parts, dimensions of all sizes, and descriptions of eleven different methods for end connections. Valves for horizontal operation, square bottom valves, many types of gearing and gear cases, and a complete listing of special controls available are included. Get Bulletin A from Rensselaer Valve Co., Troy, N. Y., by checking the reply card.

The engineering information in these helpful catalogs will aid you in your Engineering and Public Works programs. Just circle numbers you want on the reply card, sign and mail. This free Readers' Service is restricted to those actively engaged in the public works field.

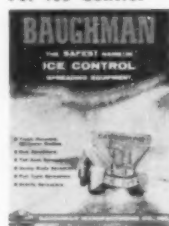
### Manual on Basic Blading, A Guide To Motor Grader Operation

532. A 32-page manual with illustrations on the use of the controls, basic blade positions and their applications, and the control positions to accomplish many of the jobs a motor grader does is available from Caterpillar Tractor Co., Peoria, Ill. Check the reply card today.

### Pavement Markers and Strippers

538. Self-propelled and truck mounted paint striping equipment for city, county and state highway departments are fully covered in bulletins from Kelly-Creswell Co., Xenia, Ohio. Specifications and methods of operation are included. Check the reply card.

### Spreading Equipment For Ice Control



For your copy of this helpful and interesting booklet check the reply card today.

### Chemical Feeder and Mixer Bulletin

545. An 8-page Bulletin No. 350-E, with numerous illustrations and diagrams of chemical feeders and mixers is available from Inflico Inc., P. O. Box 5033, Tucson, Ariz. Check the reply card for descriptions and performance data on these units.

### Metal Painting Handbook

546. Included in this 50-page handbook are sections on paint vs. corrosion, function and types of red lead, surface penetration and application, formulas and specifications. Fully illustrated, this valuable manual is available from National Lead Co., 111 Broadway, New York 6, N. Y., or by checking the reply card.

### Bulletin On Locating Trouble in Pumps

533. A bulletin to help locate and correct common ailments of rotary, centrifugal and steam pumps has been released by Worthington Corp., Merchandising Sales Dept., Harrison, N. J. Pictures give a full description of pump troubles—from failure to deliver water to the loss of capacity after starting. For copies check the reply card.

### Shoulder Stabilization With Calcium Chloride

537. A new 16-page well-illustrated catalog on shoulder stabilization includes data designed specifically for city, county and state highway engineers. It includes specifications for new construction and maintenance procedures for stabilized aggregate shoulders, and established methods for their construction and maintenance. Write to Calcium Chloride Institute, 909 Ring Bldg., Washington 6, D. C., or check the reply card.

## MORE LISTINGS ON PAGES 34 TO 52

### Vertical Turbine Pumps For Water Wells

540. The water and oil lubricated Layne vertical turbine pumps, their application, and pump drive heads designed for water wells serving municipalities and industries are described in Bulletin WO-53 from Layne & Bowler, Inc., Memphis, Tenn. Check the reply card today.

### Flow Tube For Metering Water and Sewage

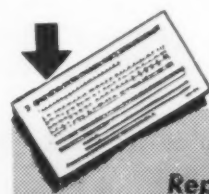
541. The Gentle "Flow Tube" is described fully in Bulletin FT available from Foster Engineering Co., 835 Lehigh Ave., Union, N. J. Advantages, applications, drawings, head loss curves and other curves showing differentials for various ratios and velocity heads are included. Check the reply card.

### Catalog Covering Traffic Signs and Reflective Pavement Marking

542. All signs with standard legends and meeting State and U. S. standard specifications are described in this buying guide plus special signs, posts and mounting accessories. It also illustrates reflective materials for pavement marking, buttons and beads. Copies available from Cataphote Corp., Toledo 10, Ohio, or by checking the reply card.

### Heavy-Duty Trucks For Maintenance and Construction Departments

544. A 20-page catalog which contains complete information on International four-wheel conventional and cab-over-engine trucks with 6-cylinder engines is available. Full-color and two-color illustrative treatment presents design and operating features of the units. Check the reply card or write Consumer Relations Dept., International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., for your copy.



Use the  
Reply Cards  
Inside Front Cover

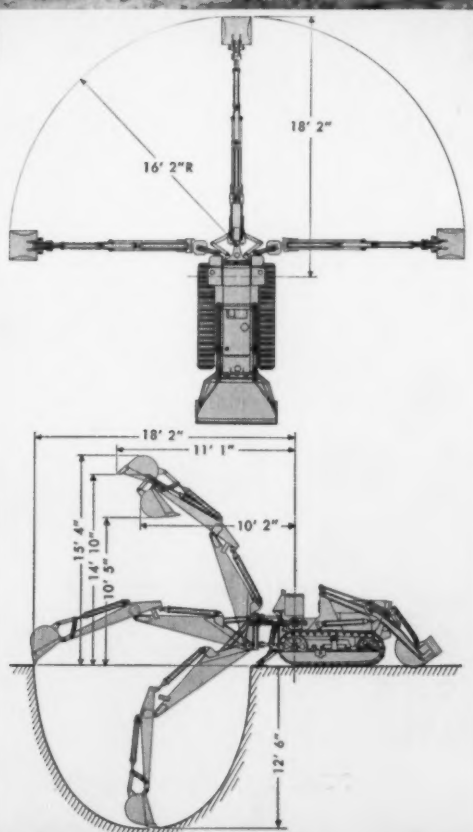


# Now...TWICE AS MUCH POWER to dig harder material FASTER!

*Plus* low-cost tilt trailer  
for high-speed mobility



Complete unit built  
and warranted  
by ONE manufacturer



Five minutes of operation will quickly convince you that no other tractor-backhoe built can match the power, speed and stability of the new hydraulically-operated TerraTrac. This is because TerraTrac gives you a much larger (30 GPM) hydraulic pump... huskier 4" diameter cylinders... heavier box-welded steel boom and dipper-stick, equipped with hardened steel pins and bushings, *plus* rugged steel castings at all major strain points. In addition, powerful hydraulically-controlled stabilizers anchor the TerraTrac backhoe firmly to the ground, so you can dig the toughest kind of material through an arc of 180° — without bouncing, tipping or being "dragged into the hole". As indicated by diagrams at left, the TerraTrac hoe *reaches further, digs deeper, dumps higher, has a wider radius of operation* than any other tractor-hoe in its price range... yet it actually costs less than most smaller-capacity wheel-type rigs.

## Write for FREE CATALOG

Detailed specifications and operating data on the new TerraTrac backhoe are quickly available in an informative 6-page bulletin — just off the press. Send post card for free copy and name of nearest TerraTrac dealer.



**AMERICAN TRACTOR CORPORATION**  
Churubusco (Ft. Wayne), Indiana

TT-B-102

To order these helpful booklets check the reply card inside front cover.

## NEW LISTINGS (Cont.)

### Valuable Catalog on Solenoid Valves

548. A new 32 page catalog, No. 201, is available from the Automatic Switch Co., Orange, N. J. The latest designs in ASCO's extensive line of 2, 3 and 4 way solenoid valves are included. It contains engineering information, flow charts, operation and construction details, illustrations and prices. Check the reply card for your copy.

### Underdrains—Hidden But Important Filter Components

549. "Armco" filter underdrain blocks are one-piece units made of vitrified salt-glazed clay. Ducts occupy 50% of floor cross section and air openings aggregate 24% of floor area. Described in several leaflets and data sheets available from Ayer-McCord Clay Co., Brazil, Ind. Check the reply card.

### Buy or Rent Flasher Safety Lights and Barricades

550. A new 3-color catalog describes and illustrates the Flasher Safety Light line of battery-powered hazard warning lights, steel and wooden barricades. The catalog contains action photos, line sketches, complete descriptions and specifications, plus details of the Flasher rental plan. For copies of the catalog write R. D. Fageol Co., Kent, Ohio, or circle the reply card.

### Chlorine Vaporizer System For Converting Liquid Chlorine To Dry Vapor

551. Information on the Whitlock vaporizer system that provides high capacity output at low equipment cost and is ideal for use in water, sewage and industrial waste plants is available from The Whitlock Mfg. Co., West Hartford 10, Conn. Check the reply card for design details, application, features and construction details.

### Asphaltic and Plastic Base Sewer Jointing Materials

552. Specifications and performance data on GS-703, a hot-poured asphaltic base sewer joint compound, GS-702, a ready-mixed cold-applied asphaltic base compound, and Root-Seal, a hot poured plastic base compound are given in a brochure available from the K. T. Snyder, Co., P. O. Box 14233, Houston 21, Texas. Check the reply card.

### Information on Filter Bottom Blocks

553. "Bosco" filter bottom blocks are all shale, thorough vitrified unglazed, with air openings occupying over 29% of the tops, and the ducts 45% of the cross-section; described in a new loose-leaf booklet giving full information on flow capacity, block details and suggested filter design. Write Bowerston Shale Co., Bowerston, Ohio, or check the reply card.

### Literature on Odor Control and Sewage Foaming

554. Literature is available from Fine Organics, Inc., 211 East 19th St., New York, N. Y., on "Cifon" that is used for odor control in connection with various sewage treatment processes and "Form-Wilt" that may be added to sewage for controlling foaming, particularly in aeration tanks. Check the reply card for your bulletins.

### Catalog on Used Construction Equipment, Attachments and Parts

555. A giant list of used equipment, attachments and parts is available from General Machinery Corp., 555 Northside Drive, Atlanta 18, Ga. Also included is complete information on replacement parts for AC, IHC and Cat tractors. Check the reply card.

### Technical Data on Fusion Welded Steel Pipe

556. Technical information as well as pictorial descriptions of the various steps in the manufacture and installation of automatic fusion welded pipe and other "Southern" products are included in a 44-page catalog from Southern Pipe & Casing Co., P. O. Box C, Azusa, Calif. Check the reply card for price lists and engineering data.

### Alum For Water and Sewage Treatment

557. Valuable information on alum that is highly efficient, dependable and an economical coagulant for removing turbidity from water, for reducing tastes, odors and colors, is available from General Chemical Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y. Sewage and water treatment plant operators check the reply card for your literature.

## WATER WORKS

### Water Level Controls for Sewage and Water Plants

31. Dependable float-operated pump and motorized valve controls for single or multiple pump installations are described in bulletins issued by the Water Level Controls Div., Healy-Ruff Co., 719 Hampden Ave., St. Paul 4, Minn. All units feature splash proof construction, mercury tube switches. Check the reply card.

### Elevated Tanks and Other Storage Facilities

32. How engineers' designs and standard AWWA specifications are followed for fabrication and erection of water storage facilities are described in color illustrated booklet. Address the Darby Corp., Kansas City, Kans., or use the handy reply card.

### Engineering Information and Water Distribution Products

49. Helpful engineering information, covering water distribution problems, is available from Mueller Company in their W-96 Water Works Catalog. The 328 page catalog features a quick reference sectional indexing arrangement for easy location and identification of the hundreds of water distribution and service products illustrated. Check the reply card and you will receive detailed information on a complete line of water works equipment.



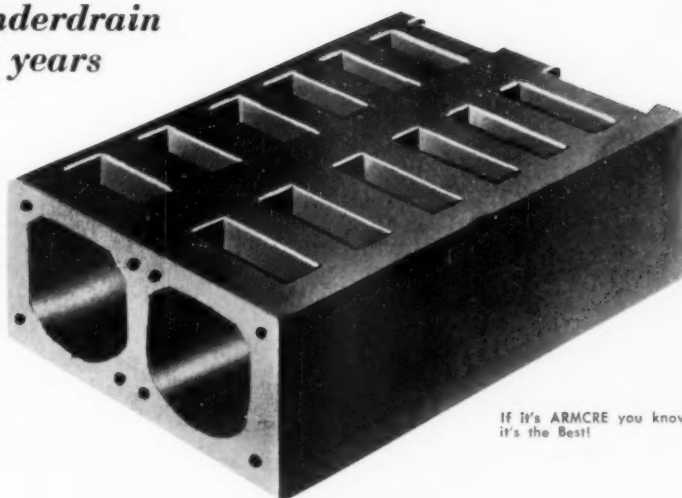
Any type and size of M & H Valve or Hydrant can be furnished with standardized Mechanical Joint end connections, to fit mechanical joint pipe and fittings made by different manufacturers.

The use of Mechanical Joints has spread steadily for 40 years until today it is more widely used than any other type of joint because it offers many advantages. M & H Mechanical Joint Valves and Hydrants are used not only with mechanical joint pipe but are easily installed in old bell-and-spigot pipe lines.

The joint is made by a bolted gland compressing a thick gasket into a stuffing box. The joint assembly is simple, rapid and practically foolproof. The gasket used for water mains is composition rubber, but metal-tipped, duck-tipped, Thiokol-tipped and other special gaskets can be supplied. The joint is bottle tight, and permits deflection, expansion or contraction without leakage. Write or wire

**M & H VALVE**  
AND FITTINGS COMPANY  
ANNISTON, ALABAMA

*Still the  
standard underdrain  
after 26 years*



If it's ARMCRE you know  
it's the Best!

# ARMCRE

## trickling filter floor blocks

- The Armcre filter underdrain block is 16" long, 10" wide and 5" high. Lengthwise through the block run two ducts approximately circular in section and 4" deep, to give a combined conduit area of 33 sq. in. per foot of width. The block has rectangular apertures on the top. Each aperture is about 3" by 1" with a total opening approximately 26% of the top surface area. The weight of each block is 26 pounds. Flow characteristics for this block show that the duct area used by a dosage rate of 30 mgad in a 150 foot diameter bed is about 33% of the entire duct area while the velocity maintained in the duct is 90% of that velocity for the duct flowing full.

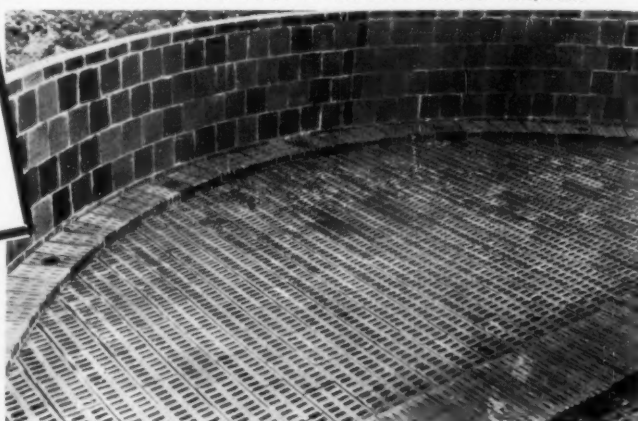
### ARMCRE WALL BLOCKS FOR TRICKLING FILTERS

SAVE 20% on the average in construction costs.  
SAVE STEEL for reinforcing other types of construction—a hard-to-get item now.

IMPROVE APPEARANCE.  
gives so attractive filter wall.

SIMPLE TO USE. Low construction cost. Exact alignment. Permanency is also an added feature of ARMCRE wall blocks.

ARMCRE wall tank blocks and filter floor blocks used at De Kalb, Texas



**AYER-McCAREL CLAY CO.**

Brazil, Indiana

Facilities of Two Plants Insure Prompt Service

PUBLIC WORKS for October, 1956

**To order these helpful booklets check the reply card inside front cover.**

**Data on Cutting-In Valves,  
Repair Sleeves and Accessories**

33. A variety of Clow products for installation and repair of cast iron pipe lines, including the Eddy cutting-in valve and sleeve, split sleeves for pipe repair, test plugs, valve boxes. Strickler pipe cutters and other fittings and accessories are featured in literature available from James B. Clow & Sons, Inc., Box 6600-A, Chicago 80, Ill. Check the reply card.

**Meters and Instruments  
For Water Works**

43. An attractively arranged 20-page booklet issued by Sparling Meter Co., 225 No. Temple City Blvd., El Monte, Calif. furnishes concise data on the full line of Sparling meters, indicator-totalizer-recorder instruments and other special instruments and controls. Check the reply card for your copy, or write for Bulletin 314.

**Dependable Source  
For All Chlorine Products**

66. Get latest data on Jones chlorine service for liquid chlorine, calcium hypochlorite and sodium hypochlorite packaged in lots best suited for your needs. Six strategic locations serve all parts of the country. Check the reply card or write John Wiley Jones Co., Caledonia, N. Y.

**Efficient Coagulation  
With Ferri-Floc**

69. Advantages claimed for Ferri-Floc as a coagulant include wide pH range, quick floc formation, manganese removal control of certain tastes and odors plus other aids in high quality water production. Check reply card for complete Ferri-Floc data. Tennessee Corp., Grant Bldg., Atlanta, Ga.

**Motor Units for Valves,  
Floorstands and Sluice Gates**

82. Complete information on Chapman motor units is available in catalog No. 51 from The Chapman Valve Manufacturing Co., Indian Orchard, Mass. Advantages, installation and operation are fully described. For more details on these units check the reply card today.

**What You Should Know  
About Pipe Locators**

94. A new, up-to-date operating manual for pipe detecting instruments has been made available by the Computer-Measurement Corp., 5528 Vineland Ave., No. Hollywood, Calif. Although written chiefly for the Detectron Model 505, it contains operating hints and other information useful with any make pipe detector. To get a copy just check the reply card.

**Rapid Sand and  
Pressure Filter Data**

109. Rapid sand filters. A complete line of vertical and horizontal pressure filters, wooden gravity filters, and filter tables and other equipment. For engineering data, write Roberts Filter Manufacturing Co., 640 Columbia Ave., Darby, Pa., or check the reply card.

**Complete Catalog  
on Pipe Line Equipment**

121. Listed under one comprehensive catalog No. 26 are a complete line of water, gas and sewer pipe line equipment. Some of the items covered are pipe cutters, diaphragm pumps, melting furnaces, calking tools, M-scope pipe finders and joint runners. Write to Joseph G. Pollard Co., Inc., New Hyde Park, N. Y., or circle the reply card for your copy.

**Helpful Reference Catalog  
on Waterworks Gate Valves**

146. All necessary details on Double Disc Parallel Seat Gate Valves for waterworks use are provided in the attractive 36-page bulletin issued by Ludlow Valve Mfg. Co., Inc., Troy, N. Y. Conveniently arranged design data shows all dimensions for 2" to 60" valves. Gearing, floor stands, operating devices are covered too. Get Bulletin 54W by checking the reply card.

**Data Offered on  
Elevated Steel Tanks**

166. Attractive designs for elevated steel water storage tanks are shown in bulletins of R. D. Cole Mfg. Co., Newman, Georgia. For copies of latest literature check reply card.

**Helpful Booklet on Carryable  
Centrifugal Pumps**

129. A booklet prepared to give practical information that will guide you in choosing the best type of pump for your requirements is offered by the Homelite Corp. Requirements are outlined for many applications. Just check the reply card for your copy. Homelite Div. of Textron American, Inc., 2125 Riverdale Ave., Port Chester, N. Y.

**A Short Course  
In Pipe Jointing**

169. The story of rubber couplings for clay and concrete pipelines is graphically presented in the booklet "Pipe Enterprise", published by Hamilton Kent Mfg. Co., Kent, Ohio. Detailed description of pipe jointing methods; photos showing jobs where Tylox gaskets met the need for easily assembled, permanently tight joints installed under all conditions; and a report on the development, manufacture and outstanding features of the compression type gasket make this booklet valuable to every engineer and contractor. Check the reply card for free copy.

**All-Electric Floatless  
Liquid Level Control**

174. Description of operating principles and application of B/W controls show the simplicity and many uses of these all-electric, floatless devices. Get latest bulletins for engineering data, diagrams of typical installations and details of component parts. Check the reply card or write B/W Controller Corp., Dept. PW, Birmingham, Mich.

**What You Should Know  
About The Centrline Process**

197. The Centrline method for cement mortar lining water mains 16" thru 144" in place to stop leaks, prevent corrosion, increase carrying capacity and decrease pumping costs is fully described in a handsome booklet issued by the Centrline Corp., 140 Cedar St., New York 6, N. Y. Many illustrations and typical case histories show the operation and economies of this process. The Tate process for lining smaller mains is also covered. Check reply card for your copy.

**Engine PROTECTION**  
WITH  
*Synchro-Start*  
**SAFETY  
ALARMS**



Synchro-Start SAFETY ALARM SETS automatically warn with visual and audible signals as soon as such conditions as low oil pressure, low air pressure and overheating, etc. occur.

Three switches are provided—control "on-off"—test—audible alarm cut-off. For added protection these alarm sets may be equipped with automatic shut-down in case signals are not heeded.

*Further information upon request.*

**SYNCHRO-START PRODUCTS**  
INCORPORATED  
8151 N. RIDGEWAY AVE. • SKOKIE, ILL.

**FILTER SAND  
AND GRAVEL**

Produced from an inland pit hence free from river contamination and foreign matter.

Shipment in bulk or bagged.

Many of the larger filter plants throughout the United States are equipped with our products.

**PROMPT SHIPMENT**

*Inquiries and orders solicited.*

**NORTHERN GRAVEL COMPANY**

Muscataine, Iowa

P.O. Box 307 Amherst 3-2711



# How would you save a failing sewer in quicksand, 42 feet underground?



Yes, it was a tough question. But Armco Liner Plates provided an easy answer. Here's the chain of events:

In Owensboro, Kentucky, an 84-inch-diameter rigid pipe trunk line, carrying sanitary and storm sewage, began to fail. It had been tunneled through quicksand, and now was developing large cracks that admitted highly fluid sand. To complicate the problem, the sewer was 42 feet underground and any repair had to be made while the sewer was in operation.

The project was opened to competitive bidding. Armco Liner Plates, combined with the know-how of Armco Construction Service, got the job. The pre-curved, corrugated metal Armco Liner Plate sections

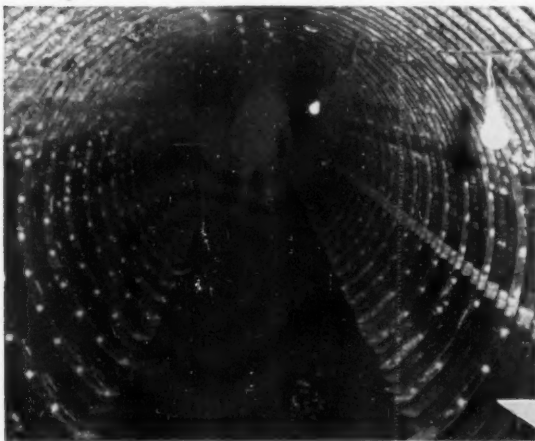
were taken into the failing sewer and bolted together from the inside to make an integral lining structure. No space was wasted. And the offset-lapped joints of Armco Plates provided extra strength.

For this sewer lining job, the Armco Liner Plate structure was 72 inches in diameter. The 10-gage plates were bituminous coated.

For more data on Armco Liner Plates, write us. Armco Drainage & Metal Products, Inc. 5486 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: Write Guelph, Ontario. Export: The Armco International Corporation.

**RIGHT:** Worker is attaching another Armco Liner Plate. Note water flowing during installation and the absence of waste space between the old and new structures.

**BELOW:** The completed Armco Liner Plate structure being inspected after a siege of high water. Note perfect alignment and high water marks.



**ARMCO**



**LINER PLATES**

To order these helpful booklets check the reply card inside front cover.

#### Bulletin on Remote Metering and Control

92. An 8-page color bulletin describing how chronoflow telemeters bring accurate records and control over an unlimited distance to the fingertips of plant operators is now available. Divided into 8 descriptive sections on various telemetering applications, the bulletin contains photos and installation drawings in addition to a description of the system's operation. Full details from Builders-Providence, Inc., Providence, R. I., or check the handy coupon.

#### Helpful Data on Water Meters

330. It is to the interest of every water works superintendent and engineer to have full data on dependable Badger water meters and related meter products. Complete data on all types of disc, turbine and compound meters, meter test equipment, yokes, strainers and alarm registers are supplied in an attractive binder by Badger Meter Mfg. Co., Milwaukee 45, Wis. Check the reply card for your copy.

#### Complete Catalog and Reference Data on Valves and Fittings

211. The entire M & H line of valves, fittings and accessories for water works, filtration, sewage disposal and fire protection are illustrated and fully detailed in Catalog 52 issued by M & H Valve & Fittings Co., Anniston, Ala. In addition to complete data on these products, there are many pages devoted to helpful engineering data. Every designer should have a copy. Get yours by checking the reply card.

#### What You Should Know About the Rubber Waterstop

448. A bulletin on the Serviced rubber waterstop has been released by Serviced Products Corp., 6051 West 65th St., Chicago 38, Ill. General information, engineering service, advantages of specifying the waterstop, specifications, general and detail requirements, installation and typical applications, standard sizes and types are fully covered. Check the reply card for your copy.

#### Are You Ready Now To Make Main Repairs?

214. Broken water main can quickly be repaired when you have "Skinner-Seal" Split Coupling Clamps on hand. Leaky bell and spigot joints are made lastingly tight with Skinner-Seal Bell Joint Clamps. Get Skinner Catalog GW now—this handsome 48-page book shows how to make every type of pipe repair and covers a complete line of clamps to do the job quickly and easily. Just check the handy reply card for your copy.

#### Does Your Water Works Have Standby Power?

224. Climax Engines are used in Municipal Water Works to supply dependable power during emergencies. They are available in a range of sizes from 40 to 600 HP and operate on either natural gas, butane, gasoline or a combination of these fuels. Use the handy reply card to obtain complete details and literature from Climax Engine & Pump Co., 208 S. La Salle St., Chicago 4, Illinois.

#### Valuable Information on Water And Waste Treatment Instrumentation

229. Helpful data on pneumatic instrumentation, flow measurement, recording controllers and rapid sand filter control systems are included in a 16-page Bulletin I-15. Get this from the Foxboro Co., Foxboro, Mass., or by checking the handy reply card.

#### Helpful Valve Catalog For Engineers

236. For complete descriptions of Darling double disc, parallel seat gate valves be sure to get Bulletin 5403 issued by Darling Valve & Mfg. Co., Williamsport, Pa. Construction details covering all valve parts and accessories are helpful for specification writers. Check the reply card for your copy.

#### Explaining the Water Diaphragm Principle of Chlorinator Operation

243. The features, operation and benefits of the water diaphragm principle of chlorinator operation are fully described and illustrated in Publication TA-1026-C-1 of Wallace & Tiernan Inc., Belleville 9, N. J. This helpful publication is yours for merely checking the reply card.

#### Attractive Bulletin Features Large Elevated Tanks

252. In a 24-page booklet "Horton Elevated Steel Tanks of Large Capacity," Chicago Bridge & Iron Co., Chicago 4, Ill., describes the advantages of using large elevated steel tanks to provide gravity pressure in municipal water systems. Detailed information on radial-cone tanks of 500,000 to 3,000,000-gal. capacity and Hortonspherical tanks of 1,000,000 to 3,000,000 gal. is included in this really handsome bulletin. Check reply card for your copy.

#### Water-Conditioning Data Book Offered To Engineers

259. All engineers and municipal officials concerned with water conditioning will want a copy of the greatly enlarged edition of the popular Permutit Data Book prepared by the Permutit Co., 330 West 42nd St., New York 36, N. Y. This completely revised book presents a compilation of 78 tables, all valuable to the engineer. Subjects include hydraulics, impurities in water, reactions and conversions of chemicals used in water treatment, alkalinity relationships and other helpful material.

#### Points to Consider in Filter Sand Selection


332. Best operation of rapid sand filters requires filter media which is hard, properly shaped, carefully graded and perfectly clean. Filter sand and gravel which meets these exacting requirements is available on short notice from Northern Gravel Company, Box 307, Muscatine, Iowa. Get full details by checking the reply card.

#### Modern Filtration of Swimming Pool Water

351. Latest data on filtration systems for swimming pools of 50,000 gallon capacity and over is presented in 24-page bulletin No. 625 by R. P. Adams Co., Inc., 225 East Park Drive, Buffalo 17, N. Y. Design and operating data are provided, together with material to assist you in choosing the right filter for your pool. Check the reply card for your copy of this helpful bulletin.

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Since your laboratory is a "Testing-Ground" and a source of improved processes and products . . . it deserves the finest equipment. Our planning service is available without any cost or obligation.

Specify METALAB and you are assured of having equipment that is completely versatile, functional, and adaptable to future operational requirements.

The equipment shown here features entire units and illustrates METALAB precision engineered interchangeable type construction.

**Outstanding features of METALAB Equipment:**

- Fireproof, waterproof, corrosion resistant, rustproof.
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- Interlocked construction and double welded.
- Bonderized cold rolled furniture steel.

General Motors Technical Center  
Detroit, Michigan

Grand Rapids Sewage Treatment Plant  
Grand Rapids, Michigan

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## METALAB Equipment Company

DIVISION OF NORBUTE CORPORATION

238 Duffy Avenue, Hicksville, L. I., New York

☐ We are interested in your free planning service.  
☐ Please send us your Supplement 55-A.

☐ Please send us your 180-page Catalog 48.

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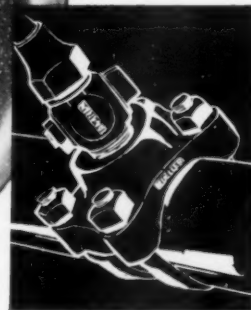
# MUELLER®



Connect services to any main!

## Service Clamp

Tapping size  $\frac{1}{2}$ " through 2"  
Iron pipe or Mueller thread  
Neoprene or lead ring gasket  
Single or double strap  
Pipe sizes 1" through 12"



Make service connections quickly and easily to steel, cast iron and all classes of asbestos cement mains. Depending upon the size required, the Mueller "E-4" or "D-4" drilling machine may be used to activate the service, under pressure, without loss of water.

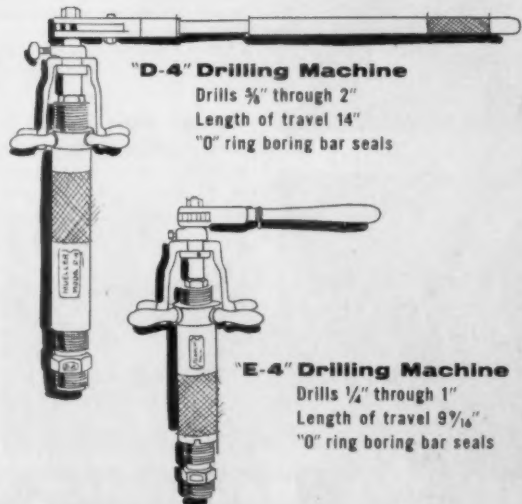
Mueller service clamps with single or double strap fit main sizes through 12". Clamps are machine-threaded with I.P. or Mueller thread to receive Mueller corporation stops with a wide variety of outlets.

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## "D-4" Drilling Machine

Drills  $\frac{3}{8}$ " through 2"  
Length of travel 14"  
"O" ring boring bar seals

## "E-4" Drilling Machine

Drills  $\frac{1}{4}$ " through 1"  
Length of travel 9  $\frac{7}{16}$ "  
"O" ring boring bar seals

## To order these helpful booklets check the reply card inside front cover.

### Information on

#### Prestressed Concrete Tanks

269. New 4-page technical Bulletin T-12 describes current trends in the design and construction of prestressed concrete tanks, including illustrations of typical tanks and standpipes. Check the reply card or write The Prelad Co., Inc., 211 East 37th St., New York 16, N. Y.

#### Standard Specifications

##### for C. I. Pipe and Fittings

278. Standard dimensions for cast iron water pipe and special castings are available in convenient booklets offered with the compliments of U. S. Pipe and Foundry Co., Birmingham 2, Ala. Get your copy by checking the reply card.

#### Tips for Installing

##### Orangeburg Pipe

336. Good practice for installation of Orangeburg pipe and fittings is outlined in an illustrated four-page bulletin made available by the Orangeburg Mfg. Co., Inc., 488 Madison Ave., New York 22, N. Y. Trenching and backfilling, pipe laying, cutting and connecting with other types of pipe are included. Use the reply card for your request.

#### Valuable Booklet on Porous

##### Diffuser Plates and Tubes

341. A helpful 16-page booklet published by the Norton Co. is a complete guide for the selection of porous media for installation in rapid sand filters and activated sludge plants. Full data are provided for the consulting engineer. Maintenance of porous media is also discussed at some length. Get Form 1246 from Norton Co., Worcester 6, Mass. by checking the reply card.

#### Engineering Data on

##### Asbestos Cement Pipe

372. Advantages of corrosion-free asbestos-cement pipe for water distribution plus full data on installation methods, cutting, making connections, testing, dimensions and weights are contained in the booklet "Mains Without Maintenance," issued by Keasby & Mattison Co., Ambler, Pa. Get your copies by checking the reply card.

#### What You Should Know About Hypochlorination

395. "Hypochlorination of Water" is the name of an informative publication issued by Olin Mathieson Chemical Corp., Industrial Chemicals Div., Baltimore 3, Md. In it there is a discussion of chlorination theory, practice and equipment; control of algae, tastes and odors; and laboratory testing. Check the reply card for this interesting literature.

#### Cleaning and Relining

##### Water Pipe the Easy Way

397. Complete facilities for relining cast iron or steel water pipe lines in place from 4" to 144" in diameter, with both the Tate process and the Centrifuge process offered by Pipe Linings, Inc., 2414 E. 223rd St., Wilmington, Calif. For full information on cleaning and relining pipe with only momentary interruption of service, check the reply card.

### For Prompt Service Use The Reply Card

#### Here's Help for

##### Laboratory Planning

369. A comprehensive laboratory planning guide that tells the engineer and designer how to obtain maximum space economy; utilize new and present facilities; and use functional design in locating utilities, ventilation and lighting is now available from Metalab Equipment Corp., Hicksville, L. I., N. Y. Complete data includes sectional and interchangeable lab equipment, furniture and accessories. Check the reply card for this valuable planning aid.

#### Helpful Engineering Data

##### on Cast Iron Pipe

422. Complete data on McWane Super-DeLavaud centrifugally cast pipe with bell and spigot or mechanical joints is contained in Bulletin WP-54, issued by McWane Cast Iron Pipe Co., Birmingham 2, Ala. Size range includes 2" through 12" diameters, 18 feet long.

#### Dependable Standby Power

##### For Water Pumping

342. The use of LeRoi generator sets for dependable low-cost standby power is discussed in an attractive bulletin, No. G-6, issued by LeRoi Div. Westinghouse Air Brake Co., Milwaukee 14, Wis. Detailed specifications are included. Check the reply card for your copy.

#### Book Tells

##### How to Control Algae

371. Details on the control of various microscopic organisms frequently found in water supplies are furnished in a 44-page booklet offered by Phelps Dodge Refining Co., 300 Park Ave., New York 22, N. Y. Check the reply card.

#### Important Factors in

##### Water Meter Selection

463. Interchangeability of parts is an important advantage that is yours when you use Trident meters. The newest parts fit your oldest Tridents so you modernize when you repair. Get full data on the entire Trident water meter line by checking the reply card or write to Neptune Meter Co., 19 West 50th St., New York 20, N. Y.

#### Bulletin Fully Explains

##### Golden-Anderson Valves

481. A new bulletin that fully explains the operation of Golden-Anderson valves has just been published by Golden-Anderson Valve Specialty Co., 1244 Ridge Ave., Pittsburgh 33, Pa. In clear concise language and with the aid of simple, easy-to-follow drawings the operation is thoroughly explained. Check the reply card today.

#### Butterfly Valves For

##### Water and Sewage Treatment Plants

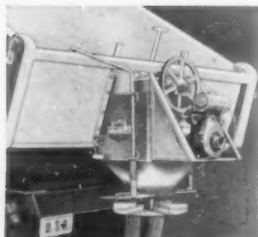
507. Rubber seated butterfly valves are described and illustrated in a new two-color Bulletin No. 5603, available from F. B. Leopold Co., Inc., Pittsburgh, Pa. Complete details on the performance and construction features of the valve are included. Check the reply card.

## NOW! THE CONTROL OF ICE AT A REASONABLE PRICE!



#### THE SALT MISER.

Hydraulic or auxiliary engine. Metering valve maintains accurate volume control. Controls permit left or right hand spread pattern.



#### MODEL MD-1.

Compact! Rugged! Operates on auxiliary engine. Spreads 8'-30'. Convenient controls for amount and direction of spread.



#### MODEL HD-51.

Hydraulic operation. Hinged mounting for always-level position of unit. Controls for volume of material and spread pattern.

#### SUPER SPREADER.

Forward or reverse spreading. Mechanical or hydraulic drive. Any material up to 1/2" dia. Fits any dump body. Hard-metal criss cross tread provides even application.



#### MODEL SC-52.

Pull-type. 360° spread pattern. Adjustable valve for quantity control.

**PLUS**  
truck-mounted  
equipment

WRITE FOR new Baughman Ice-Control Catalog.



**BAUGHMAN MANUFACTURING CO., Inc.**

224 ARCH STREET

JERSEYVILLE, ILLINOIS



# No "Cure-All," but...

*Salinas, California, finds a single grade of Bitumuls® solves five paving maintenance problems*

HERE'S A SITUATION common to most growing cities: Annexation of outlying residential developments has vastly expanded the street maintenance job *without* materially increasing available funds. Annexation has not only added to the street mileage, but has "contributed" many sub-standard pavements to the street system, thus adding to the complexity of the job.

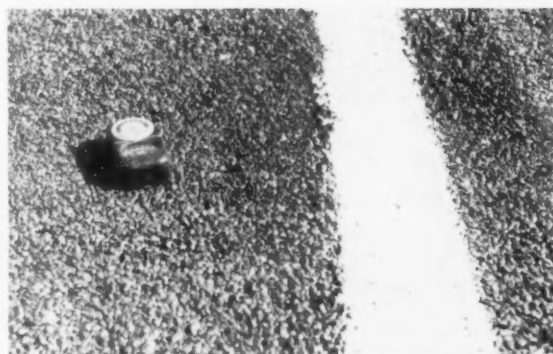
In an effort to solve this problem, these three Salinas men most directly concerned have worked together: Thomas A. Dunne, Director of Public Service; his assistant, Al Rossi; and Harry Adams, Maintenance Supt. Their search for simplicity and standardization led them to look for a versatile asphalt material that would do many jobs. They found it in Bitumuls SS-1, an asphalt emulsion that can be handled and used without heating, in small quantities or large.

Now, stored in a single 25,000-gallon tank, Bitumuls SS-1 is used for: Patching, Tack Coats, Prime, Seal Coats & Surface Treatments, and for Base Stabilization. In addition, Salinas City Forces can also use this same grade of Bitumuls for the new Slurry Sealing; and—at high dilution—for dust-laying on unpaved, outlying roads. All of these jobs can be done with existing equipment: a grader, a "Pulvimixer", a water wagon, two distributors, and a roller.

The obvious economies resulting from the use of this one material for all these jobs merit investigation by paving maintenance men everywhere, regardless of the size of their community.

There's a Bitumuls man near you who can supply details. *Call him, today, or write: American Bitumuls & Asphalt Co., 200 Bush St., San Francisco 20, Calif.*

(Right), SALES ENGINEER Bob Ridell, far left, of American Bitumuls & Asphalt Co., discusses plans with Tom Dunne, Director of Public Service for Salinas, and his assistants. At far right is a partial view of the 25,000 gal. storage tank. (Below), EVEN SCHOOL YARDS are given stabilized bases with Bitumuls SS-1.



(Top), "PULVIMIXER" reworks old pavement that has been scarified and bladed in restabilization operation. Distributor applies Bitumuls at  $\frac{3}{4}$  gal./sq. yd. per inch of depth. (Center), DISTRIBUTOR applies prime on a waterbound base, using Bitumuls SS-1 diluted (2 parts SS-1 to 1 part water) at 0.3 gal./sq. yd. of dilution. (Bottom), HERE'S A CLOSE-UP of the finished texture of a Bitumuls SS-1 Seal Coat pavement.



To order these helpful booklets check the reply card inside front cover.

## SEWERAGE AND WASTE TREATMENT

### Complete Catalog for Engineers Shows Water and Sewage Plant Equipment

191. The complete line of Jeffrey equipment for treatment of water, sewage and industrial wastes is covered in 52-page Catalog 833-A. Detailed information is provided on bar screens, grinders, grit collectors, "Jigrit" washers, sludge collectors, feeders, conveyors and other related units. Photos and drawings of installations plus capacity tables complete this valuable booklet. Use reply card or write Jeffrey Mfg. Co., 947 N. 4th St., Columbus 16, Ohio.

### What You Should Know About Trickling Filter Underdrains

20. Specifications for vitrified clay under drain blocks conforming to ASTM standards, suggestions for layout and construction of trickling filter floors, dimensions of standard blocks, channel covers, angles and other fittings are available from the Trickling Filter Floor Institute, c/o Editor, Public Works, 200 So. Broad St., Ridgewood, N. J. Check the reply card and we will forward your request.

### Do You Have An Independent Source of Electricity?

27. An independent source of electricity which will supply power for vital services when regular sources fail can be invaluable during emergencies. Check Kohler Bulletin KEP-31 which furnishes data that will help you select the plant best suited for your needs. Many models, 500 watt to 30 Kw, portable and stationary are described. Write the Kohler Co., Kohler, Wis., or use the reply card.

### Packaged Sewage Treatment—Just Right for Small Places

36. "Package" Sewage Treatment Plants specifically developed for small communities—100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., Dept. J, 622 Diversey Pkwy., Chicago 14, Ill., or check the reply card.

### "Custom-Engineered" Bar Screening In Waste Treatment

38. Low cost bar screening installations and operation are pointed out in a bulletin just released by Chain Belt Co., Dept. PR, Milwaukee 1, Wis. Details of a "Front-Cleaning" design, photos of actual installations, and mechanical features are included.

### Sewer Design Flow Chart Based on Manning Formula

154. A large-scale, convenient flow chart based on the Manning formula, together with typical examples of use, is available from Johns-Manville, 22 East 40th St., New York 16, N. Y. To get your copy check the reply card or write to the manufacturer and ask for Bulletin TR-94A.

### Reduce Labor Costs With Power Sewer Cleaners

189. A complete line of sewer cleaning equipment, including labor saving power units and all types of buckets, cables, rods and flushing equipment are listed in Catalog No. 11 of the Turbine Sewer Machine Co., Division of Chas. H. Stehling Co., 1303 N. Fourth St., Milwaukee 12, Wis. Check the reply card for your copy.

### Get Data Now on This Catch Basin Cleaner

198. Simple powerful pneumatic bucket is featured by Netco Catch Basin Cleaner. Folder 33A gives details and illustrates operation of complete self-powered truck mounted unit Netco Div., Clarke Wilcox Co., 118 Western Ave., Boston 34, Mass. Check the reply card.

### Complete Information and Installation Data on Clay Pipe

225. A fully illustrated bulletin containing complete data on vitrified clay pipe with pre-assembled Tylox flexible couplings has just been released by Universal Sewer Pipe Corporation, 1500 Union Commerce Building, Cleveland 14, Ohio. Complete information on Universal's rubber, neoprene and polyvinyl chloride resin types of Tylox couplings is included. Check the reply card today.

### How and Where to Install A Septic Tank System

270. A manual on modern sewage disposal methods for individual dwellings, camps and rural schools has just been released by Brown Co., 150 Causeway St., Boston, Mass. Location, size of and building the tank, how large a disposal field and laying out the field are discussed. Check the reply card today.

### Amvit Mechanical Jointed Clay Pipe

298. The new Amvit jointed vitrified clay pipe in sizes 4 through 24 inches with the true "built in" mechanical joint ready for immediate and easy installation is infiltration and root-proof. Offers better flow and less maintenance and permits deflection and absorbs shocks. It is furnished on all standard fittings and permits immediate backfilling and testing. For literature write to American Vitrified Products Co., National City Bank Building, Cleveland, Ohio, or check the reply card.

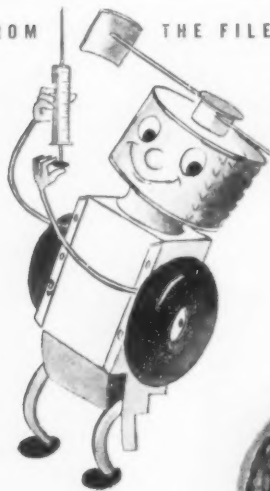
### Get the Facts on The Contact Aeration Process

303. Full engineering details on the submerged contact aeration process of sewage treatment, including diagrams of plant units, area requirements, operating costs and other details are available in a bulletin of the Hays Process Co., Box 768, Waco, Texas.

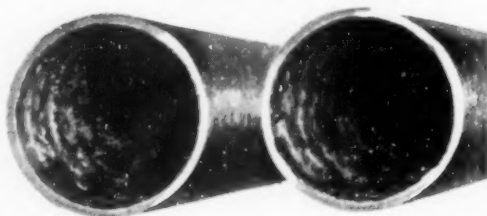
### Engineering Data on Gas Safety Equipment

343. P.F.T. Gas Safety Equipment for Controlled Digestion is the subject of an excellent 12-page bulletin issued by Pacific Flush Tank Co., Chicago 13, Ill. Full engineering data on flame traps, pressure releases, waste gas burners and related equipment is provided in convenient form. Requests for this valuable booklet must be made on business letterhead.

FROM THE FILES OF DR. CENTRILINE...



"Hmmm-Leakage!"  
This calls for  
immediate  
consultation"



### CASE #1687

- PATIENT:** 5 miles of 62" and 36" steel water mains in St. Louis, Missouri.
- SYMPTOMS:** Leakage repair costs on the increase from 1936 to 1947.
- DIAGNOSIS:** External corrosion causing pitting through the pipe wall.
- TREATMENT:** In 1947, after consultation with Centrine, pipelines were cleaned and cement-lined in place with a smooth, dense mortar lining by the Centrine Process.
- RESULTS:** The dense cement lining stopped leakage, eliminating high maintenance costs. Savings represented 13% return on the cost of cleaning and lining.\*

*This lining has paid for itself in only 8 years. Not only was the leakage stopped but the carrying capacity was increased. If your problem is leakage in steel pipe ... or capacity reducing tuberculation in steel or cast iron water mains, consider the advantages of cement lining in place.*

\*From a paper written by Mr. John B. Dean, Division Engineer, Water Div., St. Louis, Mo.

## CENTRILINE CORPORATION

A subsidiary of the Raymond Concrete Pile Company

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Branch Offices in Principal Cities  
of the United States,  
Canada and Latin America

Another  
Norton

# R<sub>x</sub> on the job!



The Newton, Mass., Municipal incinerator, recently modernized. General contractors: John F. Griffin Co., Cambridge. Refractory contractors: D. Antonellis, Inc., Brighton. CRYSTOLON engineered and prescribed refractories were specified.



Around the grate of the Newton incinerator, CRYSTOLON brick was installed in back and side walls, up to 3 feet above the sloping, movable grate.



CRYSTOLON brick was also used around the doors leading to grates, and for the front wall over the stoking door. Door arches and jambs of special CRYSTOLON shapes. Photo taken during installation.

## Complete overhauling of Newton, Mass., incinerator includes extensive use of CRYSTOLON\* refractories to protect trouble-spots.

In the modernization of old incinerator plants, just as in the building of new ones, the use of Norton engineered and prescribed refractories is the mark of up-to-the-minute construction methods.

For example, when the Newton incinerator was overhauled, CRYSTOLON refractories were the logical R's for various critical areas. The reason:

**Exceptional resistance to slags, clinkers and abrasive refuse . . . ability to withstand temperatures up to 3050°F . . . great physical strength and resistance to thermal shock and chemical attack . . . up to 15 times the resistance of ordinary fire clay to erosion and corrosion . . . extra-long, trouble-free service life.**

Investigate how these or other Norton refractory R's can save time, money and work in your own furnace operations. See your Norton Representative or write to NORTON COMPANY, 229 New Bond Street, Worcester 6, Mass. Canadian Representative: A. P. Green Fire Brick Co. Ltd., Toronto 5, Canada.

# NORTON

## REFRACTORIES

Engineered...R<sub>x</sub>...Prescribed

Making better products...to make your products better

\*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries



To order these helpful booklets check the reply card inside front cover.

#### A Handbook of Sewer Cleaning Methods and Materials

44. Complete easy-to-follow directions for every type of sewer cleaning operations and the equipment needed for effective cleaning work is covered in a 48-page booklet issued by Flexible Inc., 3786 Durango, Los Angeles 34, Calif. Full details are provided on power cleaning machines, the SewerRodeR, hand tools and all accessories. Water main and culvert cleaning methods are included.

#### Valuable Bulletin on Rodney Hunt Sluice Gate

61. Sluice gate seats on a resilient rubber seal flush with the bottom of the channel and eliminates bottom wedges and the trough in which they descend. Gives design flexibility in water filtration, sewage treatment and sluices, dam, channel and chamber flow control. For complete details write to Rodney Hunt Machine Co., 82 Lake Street, Orange, Mass. for Bulletin 75, or check the reply card.

#### Helpful Installation Manual For Drainage Structures

62. A 46-page manual, well worth careful study by designers and field engineers dealing with drainage structures, culverts, sewers or conduits, is offered by Armco Drainage & Metal Products, Inc., Middletown, Ohio. Proper location of the structures, base preparation, assembly and backfill are some of the many items covered in detail. Use the handy reply card for free copy.

#### Engineering Data on Screening Equipment

77. Water, sewage and industrial waste screening equipment is fully described in a 28-page book, No. 2587, offered by Link-Belt Co., Dept. 137, Colmar, Pa. Complete data for the engineer and tables to determine the proper size unit for handling various capacities are included. This valuable, comprehensive booklet may be obtained by checking the reply card.

#### Helpful Design Data For Sewage Ejectors

81. The application and advantages of pneumatic sewage ejectors are outlined in a

new bulletin of the Blackburn Smith Mfg. Co., Inc., Hoboken, N. J. Included are piping diagrams for electrode and float switch controls plus dimensions and layouts for single and duplex systems. Get your copy by checking the reply card.

#### Diesel Engines For Municipal Power Needs

359. Dependable power for water supply or flood control pumping stations, stationary or portable electric plants and many other municipal needs can be provided by engines described in literature of the Enterprise Engine & Machinery Co., 18th & Florida Sts., San Francisco 10, Calif. Get latest data by checking the reply card.

#### A Precast Concrete Filter Bottom

394. The Criscrete unit is precast pre-stressed concrete built monolithically spanning the entire width of the filter in one piece. It requires 6 in. overall depth in the filter and employs non ferrous nozzle liners. For complete information on this filter unit get literature available from MCG Co., 1771 W. 5th Ave., Columbus 12, Ohio, by checking the reply card.

#### Combat Unpleasant Odors At Municipal Sanitation Sites

404. Malodors at municipal refuse disposal sites, waste treatment plants and incinerators may be effectively "neutralized" by the odor masking products of Rhodia, Inc. Be sure to investigate this means of eliminating complaints from unpleasant odors. Write Rhodia, Inc., 60 East 56th St., New York 17, N. Y., or check the reply card.

#### Design and Applications of the Spiragester

419. The Spiragester is a combination of a clarifier and a digester in a single unit, compactly arranged for economical construction and ease of operation. Full data on operation, explicit design information and specifications are included in Bulletin 135, issued by Lakeside Engineering Corp., 222 West Adams, Chicago, Ill. Check the reply card for a copy.

#### How Your Filter Washing Can Be Improved

368. More effective sand washing with elimination of mud balls and bed cracking with resultant longer filter runs are claimed for the Palmer Filter Red Agitator, described in bulletins issued by Palmer Filter Equipment Co., Erie, Pa. Get latest data by checking the reply card.

#### Getting Improved Sludge Dewatering With Non-Clogging Vacuum Filters

425. Latest information on the Komline-Sanderson "Coilfilter," which features non-clogging, permanent filter media to obtain constant output and low operating cost is presented in illustrated Bulletin No. 102 by the Komline-Sanderson Engineering Corp., Peapack, N. J. Be sure to investigate this improved method of sludge dewatering. Check the reply card today.

#### Data on Adjustable-Speed Magnetic Drives for Low-Lift Pumps

465. A catalog is available from Electric Machinery Mfg. Co., Minneapolis 13, Minn., that tells all about E-M Vertical Synchronous Motors and Magnetic Drive Units. Engineers check the reply card for information on this equipment for sewage pumps.

#### Bulletins on Chlorine Gas Control Equipment

498. Sterelators, chlorine gas control equipment, for sewage plants, water works, swimming pools and industrial applications are described in bulletins available from Everson Mfg. Co., 214 W. Huron St., Chicago 10, Ill. Semi-automatic and manual control flow charts are illustrated as well as typical layouts. Check the reply card.

#### A Unit Providing Flocculation and Clarification in a Single Tank

505. Dorr-Oliver announces the availability of a new, 12-page, two-color bulletin, "The Dorrco Clariflocculator." It describes the physical characteristics, principle of operation, types, sizes and advantages of this combination flocculation and clarification mechanism. Check the reply card or write Dorr-Oliver Inc., Barry Place, Stamford, Conn.

## CUT MAINTENANCE COST in HALF with GRACE "EZ-ON" TRAFFIC SIGN FACES:

'EZ-ON' Sign Faces—patented, are made of 30 ga. steel in 3 shapes and 3 sizes—octagon, diamond, rectangular—24" and 30" and 18" x 24". The former in red and yellow, the latter in white only. Standard copy or special—or the rectangular face blank if you wish. They meet every need—at 1/2 the regular cost!

3 SHAPES... 3 SIZES!

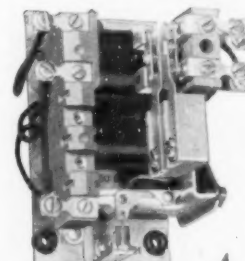


1. Slip 'EZ-ON' Face over old sign. Note wide flanges.
2. Then bend flanges backward holding 'EZ-ON' Face in place.
3. Use Crimping Tool to clamp flange and secure Sign Face.

GRACE 'EZ-ON' Sign Faces are reflectorized and meet all specifications for brilliance and reflective qualities. INVESTIGATE... and save. Their cost is HALF that of ordinary signs! SEND FOR SAMPLE SIGN. Dept. WP

**GRACE SIGN & MFG. COMPANY**  
3605 S. SECOND ST. ST. LOUIS 18, MO.

## all Electric FLOATLESS LIQUID LEVEL CONTROLS



The original—pioneered by B/W in 1933. No floats! No moving parts in liquid. Literature describes relays and starters, automatic starter and relay combinations, multiple pump controls, special controls and panels and many application diagrams.

Controls not affected by pressures, temperatures, acids or caustics. Remote control if desired. Ice free electrodes where necessary.

WRITE FOR CATALOG

**B/W CONTROLLER CORPORATION**

2224 E. Maple Road, Birmingham, Mich.



*During 7 years of heavy traffic*

## Negligible amount spent on pavement maintenance



"The Asphalt pavement on Chester Avenue (between E. 55th and E. 93rd Sts.) constructed in 1949 has stood up exceptionally well. Our maintenance on this section has been negligible." LOUIS L. DRASLER, Director of Public Service, City of Cleveland, Ohio.

Cleveland's Chester Avenue extension shows how modern Asphalt construction can mean real service to a community. And how Asphalt paving can simplify a complex job.

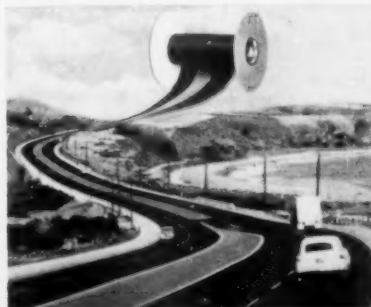
Before paving started, 118 buildings on the right-of-way had to be razed. As a result, most of the road was constructed over highly diverse subgrade.

Here's how it was done. Basements of demolished buildings were filled with compacted material over which was laid a 6" granulated slag subbase. Then, a 4" Asphalt penetration macadam base was placed and surfaced with 4" of Asphaltic concrete.

Result? A road so durable nothing fazed it. Not the heaviest trucks. Not the buses. Not the daily traffic count of over 50,000. In 7 years the road has required a negligible amount of maintenance. And today, it is still in excellent condition.

What are the reasons for this durability? Asphalt pavement seals out damaging surface moisture . . . keeps the underlying base and foundation dry and firm. It isn't affected by de-icing salts. And this flexible pavement hugs its foundation. It adjusts itself to settlements and shifts. And most important—the modern Asphalt road is tough. WASHO Road Tests prove it.

Asphalt's lower first cost and maintenance savings enable the engineer to plan safer, wider streets on smaller budgets. They enable him to get the most out of every tax dollar appropriated.



Ribbons of velvet smoothness . . .

MODERN **ASPHALT** HIGHWAYS



**THE ASPHALT INSTITUTE**

Asphalt Institute Building  
College Park, Maryland



**No one! . . . Least of all city managers and sewage plant superintendents.**

The psychological impact of odor is completely out of proportion to its importance as a health hazard. But TRY TO CONVINCE AN IRATE CITIZENRY of this fact. THE SIMPLE SOLUTION IS BIONETIC.

#### **Odor Fundamentals:**

The accumulation of grease and sludge is the principal cause of collection system odor nuisance. These accumulations provide food and shelter to odor producing organisms. Poor digestion at the plant is another major source of odor. Unwanted odor is developed both during digestion and while sludge is drying.

#### **The Remedy:**

Bionetic will remedy the principal causes of odor production. Bionetic applied on the collection system does not require high cost feeding equipment or constant supervision and removes sludge and grease economically. Application of Bionetic will produce a longer residual action than either masking agents or germicidal chemicals. Plant applications of BIONETIC to digesters, wet wells and trickling filters is equally as simple. BIONETIC IS COMPLETELY HARMLESS to humans or equipment.

#### **Experience:**

Hundreds of cities and industries, both here and abroad are now benefiting from their use of BIONETIC. LET BIONETIC HELP YOU. Many simple, economical BIONETIC solutions to waste treatment problems are on file. WRITE FOR FREE BULLETINS AND REPRINTS.

**Reliance Chemicals Corporation  
Bionetic Division**

P. O. Box 6724 Houston 5, Texas  
\*Reg. TM. Reliance Chemicals Corp. Applies only to a specific method of manufacture of preserved cultures of beneficial micro-organisms of uniform potency that are field tested in waste treatment plants.

## **SNOW AND ICE CONTROL**

### **Uniform Salt Spreading Saves Material**

42. The wide, thin pattern provided by Tarco "Scotchman" spreaders avoids salt waste, saves time and labor. Get Folder BL for full details on their spreader and table of material application rates. Use reply card or write Tarant Mfg. Co., Dept. PW, Saratoga Springs, N. Y.

### **End Dangerous Ice Hazards**

294. Many progressive municipalities use rock salt as standard practice for prevention of ice hazards on streets and highways. Get full data on Sterling "Auger-Action" Rock Salt and suggestions on storage methods from International Salt Co., Scranton, Pa. Check the reply card today.

### **Reversible and Roll-Over Type Snow Plows for any Depth of Snow**

389. Village, city, county, state and airport officials send for the latest information on Frink's two catalogues on reversible trip-blade and roll-over snow plows. Complete assembly details, specifications and operation are completely outlined. Write to Frink Sno-Plows, Inc., Clayton, Thousand Islands, New York, or check the reply card for the catalogues.

### **Catalog on Equipment For Ice and Snow Control**

410. Information on Baker snowplows and Frink ice control spreaders is available from The Frink Co., Dept. 5613, Streator, Illinois. Fully covered are reversible and one-way plows with hydraulic power lifts to meet every specification and single or dual spinner type spreaders. For reference catalog #110 check the reply card.

### **Ice Control Without Corrosion Dangers**

439. Virtually all corrosion is prevented when rust inhibitor "Banox" is used in conjunction with salt for snow and ice control. Properties of this material and performance results are described in bulletins issued by Calgon, Inc., Hagan Bldg., Pittsburgh 30, Pa. Check reply card for your copies.

## **REFUSE COLLECTION AND DISPOSAL**

### **How to Dispose of Sewage and Industrial Sludges**

281. Get full information on the C. E. Raymond System of combined incineration and sludge drying providing high temperature deodorizing for nuisance-free sludge disposal. Flexible layouts fit large and small communities. Use handy coupon or write Combustion Engineering Inc., Raymond Div., 200 Madison Ave., New York 16, N. Y.

### **How to Construct A Sanitary Fill**

331. A new 12-page booklet which tells the most efficient method of sanitary fill construction and furnishes complete information on planning and operation is now available from Drott Mfg. Corp., Milwaukee 15, Wis. Get your copy by checking the reply card; you'll find this booklet both interesting and valuable.

### **What You Should Know About Refuse Incinerators**

362. Two helpful bulletins tell what you should know about low cost refuse incineration for the small community and for larger cities. Your questions on mechanical stoking, burning rates and operating problems are discussed. Get Bulletins 217 and 223 from Nichols Engineering & Research Corp., 70 Pine St., New York 5, N. Y. Just check the reply card.

## **STREET LIGHTING AND TRAFFIC CONTROL**

### **Get Full Data**

#### **On the Radar Speed Meter**

22. Accurate readings of vehicle speeds, with direct indications in miles per hour and a graphic recorder for permanent record are available by use of the Electro-Matic Radar speed meter, a product of Automatic Signal Division, Eastern Industries Inc., Norwalk, Conn. For full data on this device, just check the reply card.

### **Investigate These**

#### **Street Lighting Standards**

54. You can get complete data on Kerrigan factory-built "Weldforged" street lighting standards, brackets and mast arms by using the handy reply card. Check these strong, well designed, inexpensive steel standards for practical street and highway lighting. Handsome 26-page folder includes data sheets on floodlighting and area lighting applications. Kerrigan Iron Works, 1033 Herman St., Nashville, Tenn.

### **A New Development**

#### **in Fluorescent Lighting**

130. A catalog on LUXaire (R), a new development in outdoor fluorescent lighting, is offered by Pfaff & Kendall, 84 Foundry St., Newark 5, N. J. The catalog illustrates actual installations, provides engineering information and suggests more than a dozen special applications.

### **Modern**

#### **Outdoor Lighting**

512. A new two-color guide to modern outdoor lighting for shopping centers and commercial parking lots is now available from the General Electric Co., Schenectady 5, N. Y. The Bulletin, designated GEA-6438, defines basic lighting terms and describes applications of effective outdoor lighting. Check the reply card.

## **CONSTRUCTION EQUIPMENT AND MATERIALS**

### **Latest Information on Tandem Rollers**

104. The tandem roller line of Huber-Warco Co., including 5-8, 8-10, 8-12 and 10-14 ton models, is covered in 16-page Bulletin HWT-501. Cross-sections, diagrams and photos point out principal engineering features which mean top performance and ease of operation. For a copy of this bulletin write Huber-Warco Co., Marion, Ohio, or check the reply card.

### **Better Paving**

#### **On Small Jobs**

176. Blaw-Knox Company's small-job paving machine, the Adnun Jr. 8, is the subject of bulletin No. 2609. The Adnun Jr. is equipped with a 12-HP motor. Hopper capacity is approximately 2 tons. It will pave an 8-ft. strip. For full engineering details and on-the-job performance data, get this bulletin from Construction Equipment Div., Blaw-Knox Co., Matoon, Illinois. Check the reply card.

### **Complete Line of**

#### **Concrete Gunning Equipment**

208. A 16-page catalog that gives complete details, specifications and operating capacities of concrete gunning equipment and answers to many of the questions asked about air placed or gunned concrete is available from Air Placement Equipment Co., 1009-11 West 24th Street, Kansas City 8, Mo. Also included are several pages of actual job application photographs showing the many and varied uses of this modern equipment. Check the handy reply card for your copy of this catalog.

Allis-Chalmers  
**LOW-COST**  
 Model **D**

**BIG**

**in power  
 in strength  
 in versatility**



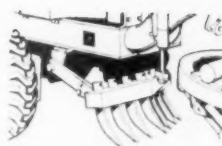
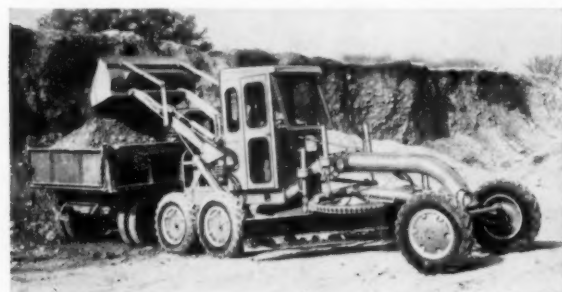
**THE MODEL D GRADER HAS THE POWER** to tackle bigger jobs. With either 50-hp gasoline engine or 50-hp diesel engine, there's extra torque and lugging ability for top performance on all projects.

**BIG-GRADER DESIGN** means long life for the Model D — regardless of the job. Strong, single-member main frame . . . husky drawbar and one-piece circle . . . work-boosting **ROLL-AWAY** moldboard . . . ground-gripping tandem drive . . . precision control . . . easy operation and simple servicing — all are plus performance advantages.

**JOB-MULTIPLYING ATTACHMENTS** make the Model D a *specialist* on many applications:—

ROLL-AWAY is an Allis-Chalmers trademark.

*See the Model D at your  
 Construction Machinery Dealer —  
 headquarters for True Original Parts and Service.*



**HYDRAULIC SCARIFIER** — exclusive mid-ship mounting under D's heavy end for better steering, maximum traction and full penetration. With seven removable teeth, scarifier cuts a swath 27¾ in. wide.

**ALSO** output-boosting extras — rear-mounted ⅝-yd loader, shoulder maintainer, windrow eliminator, snow-plow blades. Plus optional equipment — including power circle turn, shiftable moldboard, leaning front wheels, all-weather cab, heater, etc.

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION  
 MILWAUKEE 1, WISCONSIN

**ALLIS-CHALMERS**





To order these helpful booklets check the reply card inside front cover.



## SOIL MOVER Moves 100 to 150 Cu. Yds. per Hour!

Long a favorite with farmers, contractors, SOIL MOVER is ideal for road work and land fill. *Actually moves dirt for as little as 4½¢ per cu. yd.!* Hydraulically operated from tractor seat. Front pick-up, rear dump. Spreads or dumps load. Double acting cylinders. Soil Mover models available for 25 to 50 HP wheel tractors or small crawler tractors. Built to L-A-S-T, it's World's No. 1 Scraper—yet costs \$100s less than comparable road-building equipment!

**WRITE** for free literature, prices, and name of nearest dealer.

The SOIL MOVER CO., Dept. PW-10, Columbus, Nebr.

## Sterelators by Everson

Chlorine Gas Control  
Equipment  
Visible Flow Indication  
Vacuum Solution Feed



for  
Water Works  
•  
Sewage Treatment  
•  
Industrial Plants  
•  
Swimming Pools  
•  
Easy to Install  
•  
Easy to Operate  
•  
Low Maintenance  
Cost  
•

Everson STERELATORS can be furnished for fully automatic, semi-automatic and manual control.

Write for  
STERELATOR Bulletins  
**EVERSON MFG. CORP.**  
213 W. Huron St., Chicago 10, Ill.

### A Fully Rotary Compressor by Jaeger

209. Complete information is available from The Jaeger Machine Co., Columbus 16, Ohio on this 2-stage, oil-cooled rotary compressor. Features include 80% fewer moving parts, up to 30% less weight, vibrationless operation and 100° cooler air. For full details check the reply card.

### Handbook of Castings For All Public Works Construction

220. Every type of construction casting needed by engineers and contractors in the public works field will be found in a 136-page catalog issued by Neenah Foundry Co., Neenah, Wis. Detailed illustrations and complete tables of dimensions will help the designer and materials buyer. Get your copy of this valuable catalog by checking the reply card today.

### Give Full Protection To Treated Poles and Timbers

267. Bolt holes in treated poles and timbers used for guard rails and structures can easily be the first point of decay. Now you can assure maximum life by using the Greenlee Bolt Hole Treater, a simple device that forces preservative into the wood cells. Bulletin 13-15 gives the details. Write Greenlee Bros. & Co., Rockford, Ill., or check the reply card.

### Portable Melting Furnace For Rubberized Joint Sealers

357. The Hauck double jacketed melting furnaces use L-P as a fuel and a high flash point oil for heat transfer to assure close temperature control when melting rubberized joint sealers of all types. All details on this 16-gallon capacity unit are furnished in Bulletin 1081. Check reply card for your copy. Hauck Mfg. Co., 124 10th St., Brooklyn 15, N. Y.

### Information on Boring Machines

365. General operating instructions for the Earthworm boring machine, a portable compact unit for underground installation of pipe and conduit are available in new bulletin just released by Lube Jack Co., P. O. Box 1100, Santa Monica, Calif. Suggested procedures for installing pipe or conduit and a price list are included. Check the reply card.

### Get Data on Automatic Engine Control Equipment

462. Automatic controls for engine starting and overspeed protection are described in the latest Synchro-Start literature. For full application data and specifications get Catalog No. 5 from Synchro-Start Products Inc., 8151 N. Ridgeway Ave., Skokie, Ill. Requests for this valuable literature must be made on business letterhead.

### Sherman Power Digger For Digging in Any Soil

493. Sherman Major power digger literature is now available, providing details on this new hydraulic backhoe designed specifically for attachment to Fordson-Major tractors. The unit can dig to a depth of 12½ ft. and can dig through a 180° arc of swing and to a loading height of 8 ft. 8 in. Specifications and operation are fully covered. The 8-page colored catalog can be obtained from Sherman Products, Inc., 3200 West 14 Mile Road, Royal Oak, Mich., or by checking the handy reply card.

### A Most Economical Scraper For Cities and Counties

499. A scraper that is capable of moving 100 to 150 cu. yds. per hour of earth is described in literature available from the Soil Mover Co., Dept. PW-2, Columbus, Nebr. It is hydraulically operated from tractor seat and has front pick-up and rear dump and is available for 25 to 50 hp wheel tractors or small crawler tractors. For prices and other information check the reply card.

### The Crawler Tractor, Backbone of Construction

504. A new 12-page catalog published by American Tractor Corp., Churubusco (Ft. Wayne), Ind., graphically illustrates how and where the 30 to 60 hp TerraTrac tractors fit in the construction picture. Illustrations of the complete tractor line, plus a complete selection of matching loaders, dozers, backhoes, scarifiers and winches are included. Check the reply card.

## STREETS AND HIGHWAYS

### Bitumuls Paving Handbook Full of Useful Data

23. The latest edition of the Bitumuls Paving Handbook covers a wealth of practical data on paving methods and materials, road and airport paving specifications and construction details, complete tabular data on asphaltic binder applications and aggregate requirements, condensed Asphalt Institute specifications plus data on Laykold compounded asphalts for flooring, tennis courts, protective coatings and waterproofing. You can have a copy by checking the reply card. American Bitumuls & Asphalt Co., 200 Bush St., San Francisco 20, Calif.

### How to Select Prestressed Concrete Bridge Members

26. Colorful folder, well illustrated, shows manufacture of "Amdek" prestressed bridge members and provides selection tables covering several AASHTO loadings. Full data from Concrete Products Div., American Marietta Co., 104 East Ontario St., Chicago 11, Ill. Check the reply card for your copy of this helpful reference bulletin.

### Levels Sidewalks and Curbs Quickly and Easily

29. How the Mud-Jack Method for raising concrete curb, gutter, walks and streets solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a bulletin by Koehring Company, 3026 W. Concordia Ave., Milwaukee 16, Wis. Check the reply card.

### 1,001 Profitable Uses For Holmes-Owen Loader

39. The addition of a Holmes-Owen Loader to your dump truck converts it into a complete digging and loading unit that enables one man to load, haul and dump. Illustrated folder shows how this self-loading unit with hydraulic crowding action can be a real time and labor saver for the municipality or contractor. Check the handy reply card for full data. Ernest Holmes Co., Chattanooga, Tenn.

### Uses and Erection Data of Barrier Beam Guard Rail

46. Typical installations, erection instructions, specifications, curving data and physical properties of the barrier beam guard rail are fully covered in the catalog available from United Steel Fabricators, Inc., Wooster, Ohio. Plenty of photographs and drawings are included. Check the reply card.

### Safe-T-Cones Solve Traffic Problems Night and Day

136. For data on Safe-T-Cones, the all-rubber traffic guides available in two sizes, 18" and 28"—painted or reflectorized for day and nighttime use—get bulletin from Radiator Specialty Co., Charlotte, N. C. Information included on Safe-T-Signs which add greatly to value of markers. Check the reply card.

### Information on Street and Highway Signs

149. Street and highway signs that are porcelain enamel embossed are fully described in literature available from Ferro Enameling Co., 110-57th Ave., Oakland 21, Calif. Stop, speed limit, regulatory, parking, pedestrian, warning, street name and guide signs are a few of the signs mentioned. Check the handy reply card.

### How to Solve the Brush Disposal Problem

277. Fitchburg Chippers, engineered to solve the brush disposal problem, reduce troublesome brush and trimmings to tiny, easy-to-dispose-of chips. Several models are available to meet your needs. May be mounted on truck body or on trailer, tractor or jeep. Full details in interesting, profusely illustrated 16 page bulletin. Write Fitchburg Engineering Corp., Fitchburg, Mass., or check the reply card for your copy.

(Continued on page 52)



*There's a D-O UNIT for  
Practically Every Step in Every  
Sewage Treatment Flowsheet*



General view of the plant. Inset, closeup of Bar Screen and Disintegrator.  
Consulting Engineers: Ripple & Howe, Denver, Colorado.

## **DORRCO BAR SCREEN — SULZER DISINTEGRATOR** *Simplifies Screenings in Municipal and Industrial Waste Treatment Plant... Biofiltration Flowsheet*

The North Washington Sanitation District sewage treatment plant near Welby, Colorado takes care of both domestic and packing house wastes.

To reduce the coarse screenings prior to subsequent treatment steps a Dorrco Bar Screen and Dorrco Sulzer Disintegrator are used in "closed-circuit." Here's how they operate . . . screenings are fed to the Disintegrator, ground to a "mealy" consistency, and returned to the plant flow for further treatment. A portion of the Disintegrator

discharge is re-cycled to flush screenings through a trough into the Disintegrator feed sump. Electrical controls automatically operate the two units in conjunction with each other.

Other Dorr equipment in the plant includes a Clarifier, Distributor and Digester. Plant flow is 1000 GPM minimum; 2000 GPM maximum.

If you'd like more information on this modern answer to the screenings handling problem, write for a copy of Bulletin No. 6400. Dorr-Oliver Incorporated, Stamford, Connecticut.



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WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT  
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# A. W. W. A. HYDRANTS

EASY TO  
OPERATE  
AND MAINTAIN



Ludlow hydrants incorporate all the advantages and meet all the requirements for safety, durability and economy.

## HERE'S WHY:

1. **POP-OFF SLEEVE COUPLING:** releases hydrant head from stem in event of traffic damage.
2. **BREAKABLE GROUND LINE FLANGE** eliminates digging.
3. **NO FLOODING.** Closed hydrant remains locked—even in event of traffic accident.
4. **NO FREEZING.** Positive drip action, at extreme bottom, assures complete drainage.
5. **90,000 TENSILE STRENGTH** rolled Everdur threaded stem section completely eliminates stem failure.
6. **LESS OPERATING TORQUE.** New, non-binding upper and lower "O" rings trap lubricant . . . assure positive water tight seal . . . require no servicing.

**THE RESULT: LOW INITIAL COST—YEAR AFTER YEAR—OF TROUBLE-FREE SERVICE.**

"NO POSSIBLE DIFFERENCE IN FIRST COST CAN OVERBALANCE THE PERPETUAL ECONOMY OF QUALITY."

15



# THE LUDLOW



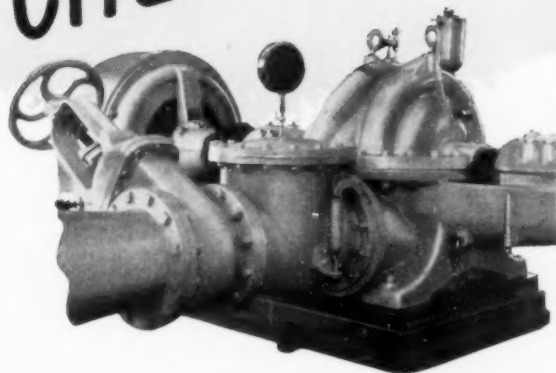
## VALVE MFG. CO., INC. TROY, N. Y.

GATE VALVES • FIRE HYDRANTS • SQUARE BOTTOM VALVES  
CHECK VALVES • TAPPING SLEEVES • AIR RELEASE VALVES

Ask for  
Bulletin 54-H



# CLEARWAY—QUIET CLOSING CHECK VALVES



Low cost insurance against severe slam on pump shut down is provided in the Rensselaer clearway, quiet closing, non-slam check valve.

In operation, the gate is normally completely out of the line of flow and head losses are extremely low, even at high velocities. The lever arm and adjustable spring force the gate toward its seat on pump shutdown and the gate seats firmly at the instant of zero velocity, without slamming.

The List 340 Spring Check Valve may be installed in either horizontal or vertical pipe lines and is made in sizes up to 30 inch and pressures of 200 lbs. with flange ends only. Dual levers and springs may be provided for extreme conditions. All parts are readily accessible through the large removable cover.

The increasing type illustrated bolts directly to the pump discharge flange, eliminates increasers and saves valuable space. For locations where slamming is not anticipated, the Rensselaer list 37 without lever and springs is recommended. For higher pressures, the List 39 operates on non-shock cold water, oil or gas up to 400 lbs. W.P.

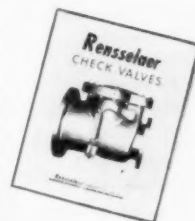


List 340 Clearway, quiet closing check valve: increasing type with flange ends.



Section view of list 340. The gate is completely out of the line of flow in open position.

Ask for  
Bulletin "E"



## Rensselaer VALVE CO.

TROY, NEW YORK

DIVISION OF  
THE LUDLOW VALVE  
MANUFACTURING CO., INC.

GATE VALVES • FIRE HYDRANTS • SQUARE BOTTOM VALVES  
CHECK VALVES • TAPPING SLEEVES • AIR RELEASE VALVES

To order these helpful booklets check the reply card inside front cover.

#### Finest Line of Markers for Fine Line Marking

165. Complete information on truck mounted highway markers, self-propelled line markers, all purpose line markers, and hand-propelled line markers is available from the M-B Corporation, New Holstein, Wis. Photographs and specifications of each type of line marker are included. For more, check the handy reply card.

#### How the "Payloador" Helps Public Officials

190. An attractive booklet "Getting More for the Tax Dollar with Payloaders" makes worthwhile reading for every public official in charge of construction and maintenance of roads, streets, and utilities. You will find illustrations and data showing dozens of ways the "Payloador" is used by cities, counties and states, plus convenient specifications on seven models. Check the reply card or write Frank G. Hough Co., 761 Seventh St., Libertyville, Ill.

#### Snow Plows for Tractors, Graders and Jeeps

207. An attractive four-page bulletin issued by Wm. Bros. Boiler and Mfg. Co., Road Machinery Div., 1057 Tenth Ave., S.E., Minneapolis 14, Minn., describes rotary snow plows that are for the front-end loader mounted models for wheel-type tractors and jeeps. Complete specifications are given and also the cutting widths.

#### The Modern Approach to the Brush Problem

222. Eliminate your brush disposal problem by using an Asplundh Chipper. For complete information on what the Chipper can do, how it can save on costs, various types available and other outstanding features write to Asplundh Chipper Co., 505 York Road, Jenkintown, Pa., or check the reply card.

#### Economical Scraper

##### Handles Many Heavy Jobs

399. Among the many applications of the versatile Model D Tournaquil are: grading and building roads; handling garbage disposal; and

grading, leveling and terracing. For details on how its speed, power and ability to work either as a self-loading tool can help your production and lower your costs, write Le Tourneau-Westinghouse Co., Peoria, Ill., or use reply card.

#### Sign Catalog Has Latest Specifications

417. Detailed information on all classifications of standard signs for traffic control, street identification and other purposes together with a complete line of accessories is presented in a convenient Sign Manual by Lyle Signs, Inc., 2731 University Ave. S. E., Minneapolis 14, Minn. Get Catalog B-55 for most recent data and specifications on U. S. Standard signs.

#### Self-Propelled Ditching Machines

438. Information on a self-propelled one man operated ditching machine, model 524 T, and a new midsize ditcher, model 4 T, for light construction is now available from the Vermeer Mfg. Co., Pella, Iowa. The Model 524 T digs 8 to 24 inches wide and down to 6 feet deep, while the model 4 T digs 6 to 14 inches wide and down to 4 1/2 feet deep. Full data on these ditchers available by checking the reply card.

#### Information on 5 Versatile Tractors For Municipal and County Work

484. Tractors that find scores of highly efficient applications in construction, municipalities, utilities and related fields are described fully in a catalog just released by Massey-Harris-Ferguson, Inc., Industrial Div., Quality Ave., Racine, Wisc. Models, specifications, attachments and uses are covered. For your catalog check the reply card.

#### Complete Line of Cleveland Trenchers and Backfillers

502. A new bulletin, released by The Cleveland Trencher Co., 20100 St. Clair Ave., Cleveland 17, Ohio, features a complete line of Cleveland trenchers and backfillers along with the recently introduced ladder-type trencher. Information on capacities, specifications and dimensions is fully covered. Check the reply card for Bulletin No. L-101.

#### New Reflectorized Sign Faces Refurbish Old Traffic Signs

292. Get complete details on new "EZ-On" traffic sign faces ready for immediate shipment. Reflectorized faces cost only a fraction as much as new signs and are easily attached to existing traffic signs. Grace Sign & Mfg. Co., St. Louis 18, Mo.

#### Information on Open Steel Mesh For Bridges

337. A 28-page catalog on open steel mesh pavement for bridges is available from Irving Subway Grating Co., Inc., 50-53 27th St., Long Island City 1, N. Y. Design data, construction and maintenance procedures and where the decking can be used are fully covered.

#### The Trucks You Need for Every Public Works Job

461. Extra life and operating economies are built-in features of every Ford truck model. There's a chassis size and engine for each of your needs, from light utility work to heavy-duty construction jobs. Get latest literature from Ford Motor Co., Truck Div., Dearborn, Mich., by checking the reply card.

#### Blade For Tractor Makes Efficient Earth Mover

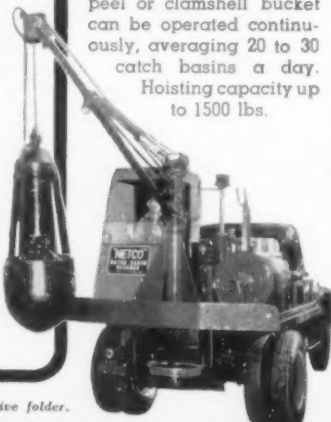
497. Literature on a rear mounted blade that fits most makes of light tractors is described in literature available from Danuser Machine Co., 533 East 3rd St., Fulton, Mo. Rugged construction makes this heavy-duty tool fine for landscaping, grading, ditching, scraping and backfilling. For full details check the reply card.

#### Snow Loaders That Pay Off All Year 'Round

526. Multipurpose loaders that have high capacity and easy maneuverability as snow loaders and as versatile loaders in the summer season to handle coal or easily convert to leaf and aggregate loaders are fully described in literature available from Barber-Greene, Aurora, Illinois. Check the reply card for capacity, loading rates and specifications.

## New NETCO Catch Basin Cleaners are Working Throughout the Land in These Cities

Chicago, Illinois  
Indianapolis, Ind.  
Cumberland, Md.  
Boston, Mass.  
Fitchburg, Mass.  
Lowell, Mass.  
Grand Rapids, Mich.  
Trenton, N. J.  
Westfield, N. J.  
Binghamton, N. Y.  
City of N. Y., N. Y.  
Utica, N. Y.  
Parma, Ohio  
Philadelphia, Pa.  
Pa. Turnpike Comm.  
Hamilton, Toronto  
Canada



Easily mounted on any short wheel base truck with 8 ft. in back of the cab, the NETCO with orange peel or clamshell bucket can be operated continuously, averaging 20 to 30 catch basins a day. Hoisting capacity up to 1500 lbs.

Send for our 6 page descriptive folder.



**NETCO DIVISION**  
CLARK-WILCOX COMPANY  
118 Western Avenue  
Boston 34, Massachusetts

## THE CROSS I BEAR!



The easy jobs are never assigned to me. I can't lie around and take it easy, and I never get a rest. When I'm put into service I kiss the world good-bye, 'cause I'll be gone for a long, long time and there'll be no rest periods.

Mine's the job that has to be done day and night for hundreds of years. But never worry . . . I'm Alabama's Super De Lavaud Cast Iron Pipe . . . I'll be rendering efficient and economical service when the others have dropped by the wayside.

In sizes of 3" to 24" in modern long lengths . . . Bell and Spigot, Roll-on-Joint and Mechanical Joint.

## ALABAMA PIPE COMPANY

We invite inquiries to our nearest sales office—

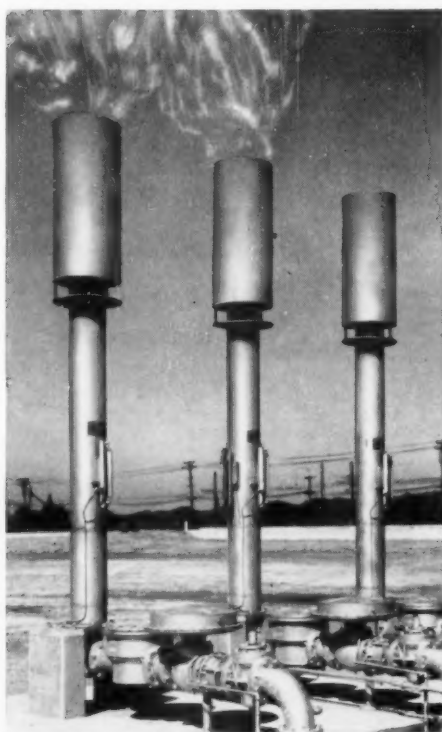
122 So. Michigan Avenue Chicago 3, Ill. 350 Fifth Avenue New York 1, New York

*General Sales Offices*  
ANNISTON, ALABAMA





*In the East Bay Municipal Utility District plant  
at Oakland, California . . .*



The P.F.T. Waste Gas Burner consists of a baffled burner pot mounted on top of an insulated pedestal. Burner pots are provided with adequate baffled air inlets to permit continuous operation of a gas pilot and provide for intermittent combustion of excess gas through a wide range of flows. The insulated pedestal minimizes formation of condensate and prevents freezing.

## **excess gas is safely burned with P. F. T. WASTE GAS BURNERS**

At this plant serving communities in the Bay area, three 95 ft. diameter digesters produce more gas than is needed for digester heating. To avoid resulting odor nuisance, East Bay's engineers have had three P.F.T. 6" Waste Gas Burners installed for safe, convenient elimination of excess gas.

For control and protection, each burner is equipped with a P.F.T. 4" Pressure Relief Waste Gas Flame Trap, completely eliminating hazards.

In addition to this gas safety equipment, the following P.F.T. products are installed in the plant: 3 Floating Covers for the 95' digesters; 3 Heater and Heat Exchanger Units (1,200,000 B.T.U./hr.); 3 Cover Position Indicators; miscellaneous gas control equipment.

Complete information and diagram of P.F.T. Gas Safety Equipment upon request—Bulletin 321.

*Design of / Engineers of East Bay  
plant by / Municipal Utility District*



waste treatment equipment  
exclusively since 1893

### **PACIFIC FLUSH TANK CO.**

4241 Ravenswood Avenue  
Chicago 13, Illinois

PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

**LOOK TO THE ALLIS-CHALMERS LINE . . . TO**

# Match the needs of your tractor

**If you're looking for big capacity, mobility and wide-range versatility — at low cost — the tractor shovel you need is in the Allis-Chalmers line.**

First — advanced-design features make Allis-Chalmers tractor shovels the most productive and widely accepted in earth-moving and material handling fields. Second — each unit offers a shovel that's a built-in part of the tractor — not just an attachment. Third — you have a choice of four sizes to match the needs of your jobs most efficiently.

You can increase Allis-Chalmers tractor shovel usefulness even more by replacing the standard bucket with a variety of quick-change attachments, such as a light materials bucket, rock bucket or rock fork . . . or by adding a rear-mounted ripper.

On every job, your Allis-Chalmers tractor shovel provides all these important advantages for you and your operator:

- Superior balance and low center of gravity
- Sure-footed stability with extra long track
- Greater strength with heavy, welded-steel shovel, side frames and low stabilizer
- Bucket design that makes loading and dumping fast, clean and easy
- Simplified hydraulics with 3-way, full-flow filtering
- Powerful, long-life Allis-Chalmers diesel engine
- All-steel main frame and one-piece final drive and steering clutch housing
- Timesaving service simplicity
- Heavy-duty roller bearing truck wheels
- 1,000-hour lube intervals on truck wheels, idlers and support rollers
- Better visibility, comfortable seats, and easy operating, accessible controls

**4YD**

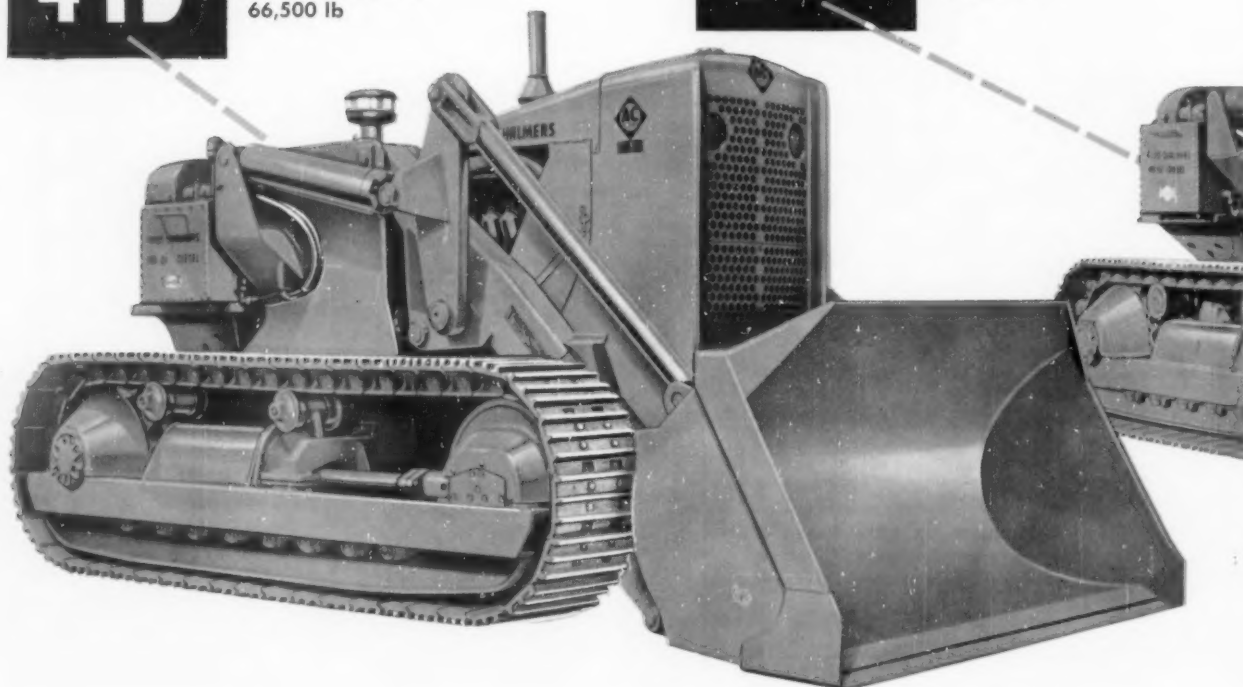
## **HD-21G**

torque converter drive  
13-ft, 4-in. dump height  
204 net engine hp  
66,500 lb

**3YD**

## **HD-16G**

torque converter drive  
12-ft, 3-in. dump height  
150 net engine hp  
47,800 lb



# shovel jobs

**1½ YD**

## HD-6G

10-ft dump height  
57 net engine hp  
19,600 lb



**2¼ YD**

## HD-11G

11-ft, 7-in. dump height  
105 net engine hp  
32,000 lb



Ask your Allis-Chalmers Construction Machinery dealer for the complete story and for a look at one of these great tractor shovels at work. And remember, your dealer is headquarters for factory-trained servicemen, factory-approved facilities and complete stocks of True Original Parts.

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION  
MILWAUKEE 1, WISCONSIN

# ALLIS-CHALMERS



# STRATEGICALLY LOCATED AMERICAN- CONCRETE PRODUCTS FOR MULTI-



## ROUND PIPE

As the nation's largest maker of concrete culvert and drainage pipe, American-Marietta offers contractors round pipe of known permanence and performance. A full range of sizes is available, with pre-tested strengths to meet various specifications. For extreme loads see Hi-Hed Pipe, below.



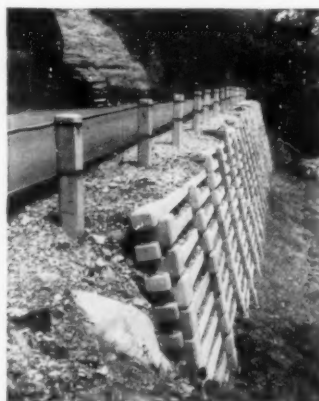
## HI-HED PIPE

Elliptical Hi-Hed Reinforced Concrete Pipe permits greater self-cleansing velocities in dry weather periods. Also perfect for drainage structures under unlimited fills because Hi-Hed has 50% greater strength than its round pipe equivalent.



## FLAT BASE PIPE

Save as much as 30% in the construction of pedestrian underpasses, culverts and cattle passes with pre-cast Flat-Base Pipe. Can be jacked under highways without disturbing traffic.

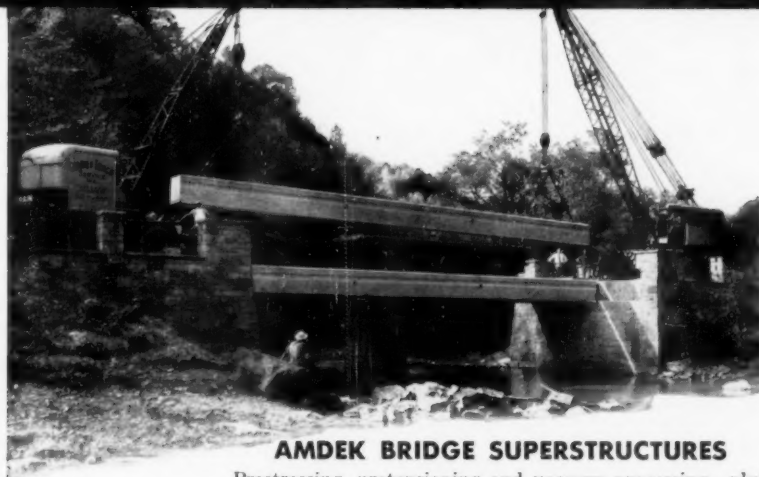


## CONCRETE CRIBBING

Used as a retaining wall, both open-faced and closed-face "King-Size" Cribbing offer flexible construction unaffected by movements that crack monolithic walls.



# MARIETTA PLANTS READY TO SUPPLY BILLION DOLLAR HIGHWAY PROGRAM



## AMDEK BRIDGE SUPERSTRUCTURES

Prestressing, pretensioning and vacuum processing—plus the use of special voids—results in a stronger, lighter bridge member that can be handled like steel beams in any weather. Pre-cast Amdek sections, above, were positioned in just six hours. Amdek eliminates painting and maintenance.

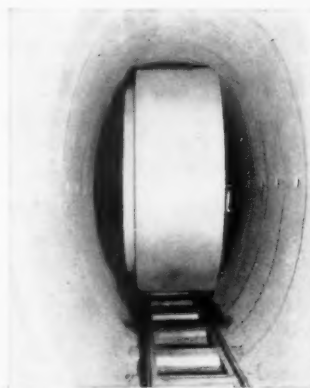


## LO-HED PIPE

Elliptical Lo-Hed Pipe carries a greater flow than its round equivalent—in a minimum depth of cut with increased depth of cover. Easier to lay, to grade and line. Pre-tested strengths to answer any low headroom problem.

A giant in the construction materials industry, American-Marietta offers a related group of essential concrete products for use in building and rebuilding the nation's highways.

American-Marietta has expanded its plants to supply the increased demand and to prepare for still more volume. Manufacturing facilities are strategically located throughout the United States to assure distribution near points of use. Send for complete information about any of the products illustrated on these pages.



## INNER CIRCLES

Tunneliner Process allows passing of pipe through pipe underground without requiring excavations or disruption of surface traffic. Work progresses regardless of weather conditions.

*Our technical staff will be pleased to assist you with your problems.*



## AMERICAN-MARIETTA COMPANY CONCRETE PRODUCTS DIVISION

GENERAL OFFICES: AMERICAN-MARIETTA BUILDING, 101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS • PHONE WHITEHALL 4-5600

### DIVISIONS AND SUBSIDIARIES

Atlantic Concrete Pipe Co.  
Concrete Conduit Company  
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Lamar Pipe and Tile Company

Lewistown Pipe Company  
Universal Concrete Pipe Co.  
American-Marietta Company of Pennsylvania

★ ★ ★ ★ ★

# FIRST

## STEEL MESH DECK

*Still Making History!*



The first installation of an open steel grid flooring on any bridge in the world was made in 1932, on the University Bridge, Seattle, Washington, by the Irving Subway Grating Co. The previous solid pavement on the bridge had been plagued by frequent repairs and accidents.

After 24 years this decking is still in service on the Seattle Bridge. It has had no major repairs and has never even been painted. Not a single accident has occurred due to the bridge flooring.

Since then, 80% open Irving Decking has been used advantageously on hundreds of other bridges.

This remarkable record of service speaks for itself.

★  
Write for complete information on  
Irving Bridge Decking.

**ECONOMICAL**

**SAFE**

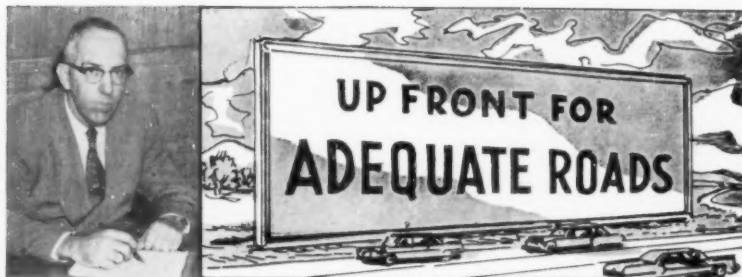
**DURABLE**

"A Fitting Grating  
for Every Purpose"

# IRVICO

**IRVING SUBWAY GRATING CO., Inc.**  
Originators of the Grating Industry

Offices and Plants at  
5053 27th St., LONG ISLAND CITY 1, N. Y.  
1853 10th St., OAKLAND 23, CALIFORNIA



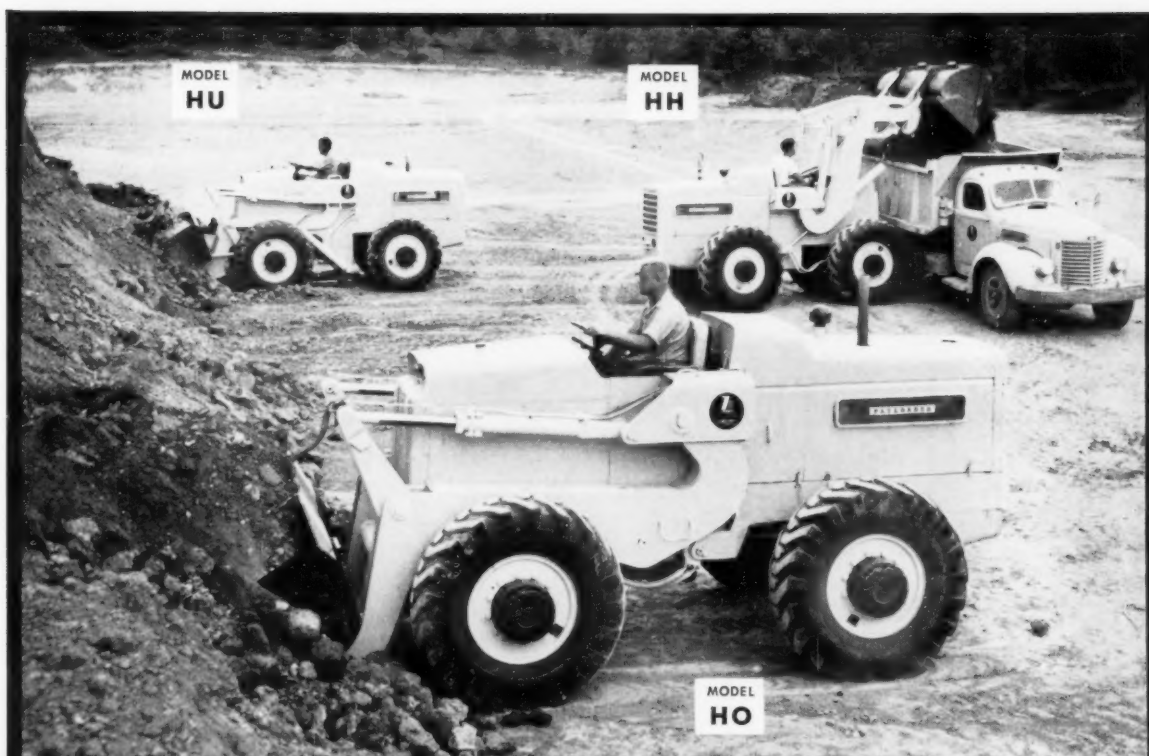
by **LEO J. RITTER, JR.**  
Highway Consultant

**Highway Program**—Developments in the new highway program continue to take place at a rapid rate. Construction is already under way on many projects, using federal-aid funds for the new fiscal year. Almost overlooked in the rush of happenings during the hectic last days of the congressional session was the fact that a bill was passed (in the last two days of the session) creating the new office of Federal Highway Administrator. The new man, who has not yet been named, will head the Bureau of Public Roads; he will be appointed by the President and must have confirmation from the Senate. This job is that of a "super" highway administrator, since the present titular head of the BPR—the Commissioner of Public Roads—remains. In July, new geometric design standards for the construction of the National System of Interstate and Defense Highways were adopted by AASHO and approved by the Bureau of Public Roads. Basic features of the design standards include control of access, elimination of most intersections at grade, and elimination of all railroad grade crossings. In general, these highways will be divided, with four or more lanes—except in areas where the traffic expected in 1975 does not exceed 5000 vehicles daily. Other geometric standards are correspondingly high. The BPR has also released figures relative to material and manpower requirements for all highway construction over the next 13 years. Basic estimates include the following: steel, 49 million tons; cement, 1,399 million barrels; bituminous materials, 128 million tons; aggregate, 9,711 million tons; and manpower, 442,000 men employed directly in highway construction at the peak of the program. No wonder it is being called the "greatest public works program in the history of the world." Even then, our highway problems are not going to be solved.

**Student Program**—The New York State Department of Public Works recently held a "Student Engineers' Institute" in the State Education Building in Albany. In attendance were some 150 student engineers, most of whom were on vacation from college and all of whom were employed in state service. The one-day session is a part of the state's new recruiting program for engineers and was designed to sell the students on the advantages of state service.

**Excellent**—The Asphalt Institute has issued a new manual, entitled "Mix Design Methods for Hot-Mix Asphalt Paving." This fine manual covers the following methods of design: Marshall, Hveem, Hubbard-Field, and Smith Triaxial. The manual meets a long-felt need by bringing these methods together under one cover. We highly recommend it. It is available on request from Asphalt Institute district offices over the country or the Asphalt Institute, Asphalt Institute Building, University of Maryland, College Park, Maryland.

**State Highway Salaries**—The American Road Builders Association has released its Fourth Survey of State Highway Engineers' Salaries; salaries shown are those in effect April 30, 1956. The tabulation is sprinkled with red figures, meaning that the salaries shown in red have been increased since September, 1954. Increased salaries are encouraging, and reflect the efforts of ARBA, AASHO, and many other organizations in improving the status of highway engineers in state service. However, we still get a little discouraged when we look at some of the figures and think about trying to interest young men in highway engineering as a career. For example, the average minimum salary for a district engineer is \$7540 and the average maximum salary \$8930. Only in seven states can a district engineer earn more than \$10,000 per year. Now, your average district



## 3 PAYLOADER<sup>®</sup> TRACTOR-SHOVELS

Now you have a choice of three sizes of 4-wheel-drive "PAYLOADER" tractor-shovels, each with *all* the more-productive features pioneered and proven by The Frank G. Hough Co.

They have power-transfer differentials—an exclusive "PAYLOADER" tractor-shovel feature that maintains effective traction on mud, gravel, ice and snow.

They have "no-stop" power-shift transmissions and torque converters . . . planetary final drives . . . power-steering and 4-wheel power brakes.

They have the exclusive bucket motion with 40° bucket tip-back at ground level and powerful pry-out action.

For proof of their superior performance and greater productive capacity, ask your "PAYLOADER" distributor for a demonstration.



**PAYLOADER<sup>®</sup>**  
MANUFACTURED BY  
**THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.**  
SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY



## Better 3 Ways

**DIG MORE** Powerful pry-out action and 40° bucket tip-back at ground level get full bucket loads with less spillage loss. Power-transfer differentials provide sure-footed traction for digging power.

**CARRY MORE** Bucket carry position is close and low for maximum stability. Hydraulic system shock absorber cushions loaded bucket—smooths the ride—permits higher carrying speeds with less spillage.

**DELIVER MORE** Since you get MORE to begin with and keep MORE while traveling at higher speeds . . . with less spillage in both instances . . . the result—you deliver more yards per load and more loads per hour.

### THE FRANK G. HOUGH CO.

761 Sunnyside Ave., Libertyville, Ill.

Send full data on 4-wheel-drive "PAYLOADER" tractor-shovels.

<input type="checkbox"/> model HO	<input type="checkbox"/> model HH	<input type="checkbox"/> model HU
2 1/4 yd. heaped	1 3/4 yd. heaped	1 1/2 yd. heaped
1 3/4 yd. struck	1 1/2 yd. struck	1 yd. struck

NAME \_\_\_\_\_  
TITLE \_\_\_\_\_  
COMPANY \_\_\_\_\_  
STREET \_\_\_\_\_  
CITY \_\_\_\_\_  
STATE \_\_\_\_\_



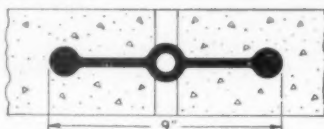
# Water Leakage Problems IN CONCRETE STRUCTURES ?



## *—Specify and use Serviced* **RUBBER WATERSTOP**

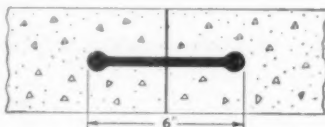
### **HOLLOW BULB—FOR EXPANSION JOINTS**

Insures permanent, watertight seals in joints where considerable movement due to expansion and contraction is expected. Flexible and elastic with a very high degree of tensile strength to withstand both lateral and shearing movement. Widths—6" and 9" . . . lengths to order.



### **FLAT DUMBBELL—FOR CONTRACTION OR EXPANSION JOINTS**

Made of durable, elastic cured rubber which has high tensile strength and flexibility for effective sealing of contraction and expansion joints against hydrostatic pressure. Carefully manufactured to insure dense, homogeneous cross section for greatest service life. Widths—6" and 9" . . . lengths to order.



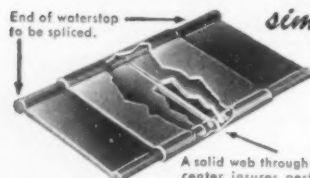
## **SPLIT TYPE WATERSTOP** *faster, easier installation*

A new Serviced development already in wide use because it reduces installation time and cost by eliminating splitting of form. One half of width is split to permit fastening to inside of bulkhead in the form of a "T." After section is poured, form is removed and divided sections are joined together by stapling. Pat. Pend.



## **WATERSTOP UNION**

### *simplifies Field Splicing*



Permits a faster, simpler method of field splicing, using only rubber cement. The union is hollow and is made from rubber meeting the same specifications as the waterstop. Available for splicing 6" and 5" Dumbbell and 6" and 9" Hollow Bulb Waterstops. Pat. Pend.

**Write for Special Waterstop Catalog.**



# **SERVICISED PRODUCTS**

**CORPORATION**

6051 WEST 65th STREET • CHICAGO 38, ILLINOIS

engineer in a state highway department is no punk. He probably has 15 or more years of experience, is a graduate and a registered professional engineer; and he has responsibility for supervision of many millions of dollars of construction every year. Yet, his salary is not high—not compared with the beginning salaries graduate engineers are getting. In our area, for example, a new graduate civil engineer can command a starting salary of \$5400 per year, and probably has his pick of at least a dozen good jobs. Will he be attracted into the state highway department? On the average, no. Why? Not because of starting salary, but because he can see his limited top—the amount he will be earning 10, 15 or 20 years in the future. This and other facts, emphasize that we must all keep working toward the goal of increased salaries and greater professional opportunity for engineers in government service.

**New Equipment**—Soiltest, Inc., of Chicago has come out with a wonderful new series of all-purpose machines for the compression and flexural testing of all sorts of materials. The largest model has a capacity of 30,000 pounds; the basic machine sells for about \$1600. The unit can be used for concrete compression and flexural tests; CBR penetration tests on soils; unconfined compression tests on soils and bituminous mixtures; Hubbard-Field and Hveem tests on asphaltic mixtures; and many other tests. The company calls it a "Versa-Tester". It is designed for laboratory use. Soiltest also has a new balloon-type apparatus for density determinations on soils and a new pocket penetrometer for estimating the consistency and unconfined compressive strength of cohesive soils. Incidentally, watch for their new series of testing manuals; the first in the series will cover the unconfined compression testing of cohesive soils and will be released soon.

**Briefs**—According to a recent issue of Minnesota Highways, the Minnesota State Highway Department has planted some 160 more miles of live pine tree snow fencing this year. The pine tree fencing replaces the conventional wood slat type of snow fence. Experience over three years has indicated that this type of "fencing" is highly successful, and eliminates the costs of placing and removing slat fencing. Planted as seedlings, the trees will grow to a height of 12 to 15 feet in 10 to 12 years.

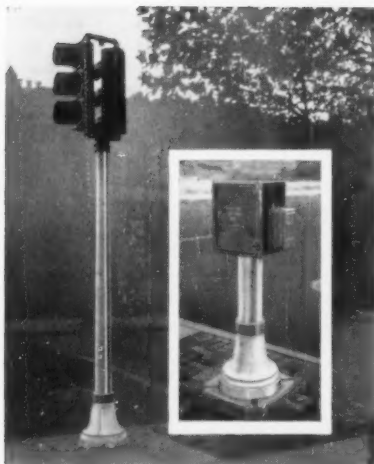
The disastrous floods of last year

PUBLIC WORKS for October, 1956

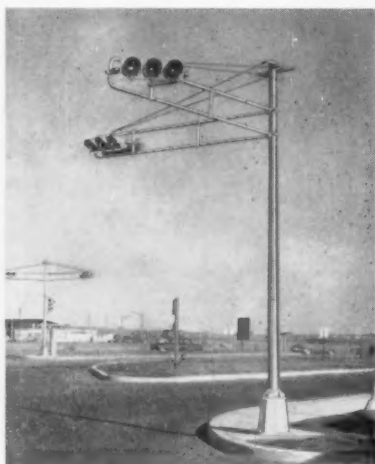


# For **MODERN**

highway and municipal traffic control...



**TRAFFIC LIGHT AND CONTROL BOX POSTS**—As designed for and being installed in New York City to replace previously used steel posts at an average saving of up to \$30.00 per unit.



**TROMBONE ARM STANDARD**—Equipped with a double and single signal on twin arms with swivel mount for angular adjustments. Available with arms up to 15 feet.



**PA SIGN POST**—Adjustable type, designed for general use and for electrified signs.



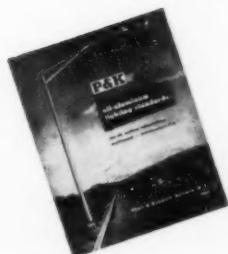
**MAST ARM STANDARD**—Model shown is equipped with walk-wait pedestrian signals. Supplied with arms up to 25 feet.

**P&K** all-aluminum  
maintenance-free  
standards and posts

P & K IS NOW PRODUCING ALL-ALUMINUM HIGHWAY SIGN SPANS IN A WIDE RANGE OF LENGTHS AND LOADINGS.

**WHY MORE AND MORE COMMUNITIES AND HIGHWAY DEPARTMENTS ARE SPECIFYING P & K TRAFFIC POSTS AND ARMS . . .**

. . . P & K All-Aluminum Standards and Posts prove the wisest investment . . . because of easy installation, negligible corrosion, long, maintenance-free life, and unusually great resistance to storms, winds, and knock-down damage.



WRITE FOR LATEST  
P & K CATALOG...  
and use the P & K  
planning and advisory  
services without obligation.

**P faff & K endall**

84 Foundry Street  
Newark 5, New Jersey

**Saved...**  
a LIFE, a cargo  
and a complete rig!



On an icy stretch of the West Virginia Turnpike last winter, a driver lost control of his loaded tractor-trailer and headed for a deep ravine. The entire rig smashed into the Barrier-Beam guard rail, was deflected and came to a stop on its wheels with cargo intact and driver unharmed.

## **Specify** **BEAM-TYPE** **GUARD RAIL**



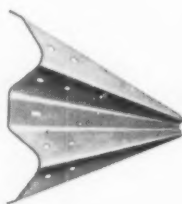
### **BARRIER-BEAM**

A rugged deep beam section with the famous rounded Safety-Top, noted for high impact strength, good deflection, maximum protection and ease of installation and maintenance.




### **UNIVERSAL-BEAM**

A standardized interchangeable deep beam rail having turned-back edges and featuring easy erection, strength, and simplification of purchasing, stocks, and maintenance.




**Write for Literature**



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**UNITED STEEL FABRICATORS, INC.**

**WOOSTER, OHIO**



**PRODUCTS**

Hollow Metal Doors • Prefabricated Metal Buildings • Window Walls  
Highway Guard Rail • Bridge Flooring • Corrugated Metal Pipe  
Sectional Plate Pipe and Pipe Arches

provided data for the development of a formula by which scour at highway bridges can be predicted with reasonable accuracy by engineers of the Connecticut State Highway Department. Comprehensive studies were made at 18 bridges in developing the formula. A mimeographed report on scour was released last spring by the Foundation Section of the Department.

Research is continuing at the University of Wisconsin in investigating the physical properties of bituminous paving mixtures treated with spent sulfite liquor from the state's many pulp mills. The material appears to have advantages in the reworking of old bituminous road-mix surfaces to provide a rehabilitated surface at low cost.

**California**—Nearly every issue of *California Highways and Public Works*, published by the California Division of Highways (PO Box 1499, Sacramento) contains articles which are of interest to engineers all over the country. The July-August issue is no exception. Included are an article by George Webb and Karl Moskowitz on "Freeway Traffic Flow"; a report on "Open Graded Plant-Mixed Bituminous Surfacing" by W. C. Carroll; and another on the effectiveness of certain street markings in improving traffic flow on Colorado Street in Pasadena, by the City Engineer, D. C. MacKenzie.

**From Here and There**—Another major step in the improvement of U.S. 29, "Main Street of the South" will be undertaken shortly, with the approval of plans to construct a 7-mile, four-lane expressway and bypass at Athens, Georgia. Like the cost of living, the various highway construction cost indexes keep edging upward; the BPR cost index for federal-aid highway construction was 135.4 (based on 1946) for the second quarter of 1956 and only 2.9 percent less than the all-time peak registered in the first quarter of 1953. Another traffic bottleneck will be eliminated in February when the new bridge across the Manatee River between Palmetto and Bradenton (Florida) is scheduled to be opened. Lay your plans now for attending the ARBA Convention and Road Show in Chicago's International Amphitheatre January 28 to February 2. The Missouri Highway Department let the first contracts under the new road program, utilizing funds made available by the Federal Highway Act of 1956. 1956 is the bicentennial of the birth of John Loudon Macadam, Britain's "Colossus of Roads."

# STOP THOSE LEAKS!

## DON'T WASTE YOUR PRECIOUS WATER!

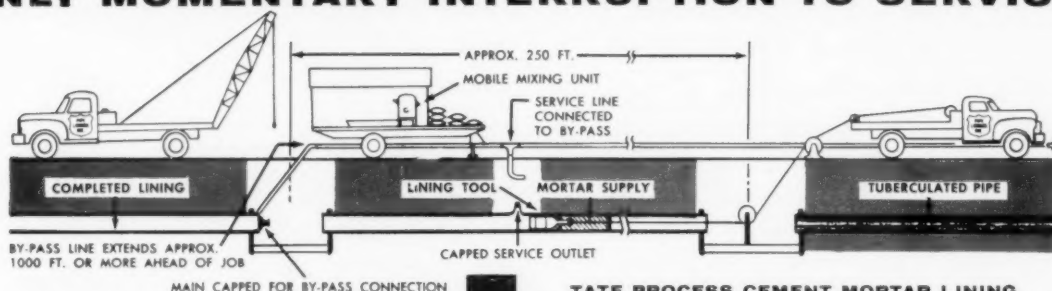
Little leaks *do* lead to big losses. If your lines look like this...or only partially resemble the illustration...you need a leak-stopping cement-mortar lining inside your lines. Easily applied...quickly applied...economically applied by Pipe Linings, Inc....specialists in cement mortar lining of the interior of pipelines "in place" by the Tate Process.

LOOK HOW LITTLE  
LEAKS LEAD TO  
BIG LOSSES

Diameter of Opening*	Gallons Lost Each Year
1/32	76,000
1/16	300,000
1/8	1,200,000
3/16	2,700,000
1/4	3,600,000

\*At 60 lbs. pressure (orifice formula)

## ONLY MOMENTARY INTERRUPTION TO SERVICE!



The economical way to line pipe 4" to 16" in diameter "in place"! A temporary pipeline laid parallel to the existing pipe serves the customer while work is being done. The existing pipe may be cleaned and lined at a rate of approximately 750 feet per day. Cement mortar linings normally 3/16" to 1/4" thick are applied at a pressure of approximately 100 pounds per square inch. Leaks are stopped... water loss is eliminated... operating costs are reduced.

**WRITE TODAY** on your organization letterhead, for the new 12 page color catalog *Cement Mortar Lining of Pipelines "In Place."* Contains complete explanation, application photos, specifications for work done by the Tate Process.



### TATE PROCESS CEMENT MORTAR LINING FOR PIPELINES 4" TO 16" GIVES YOU...

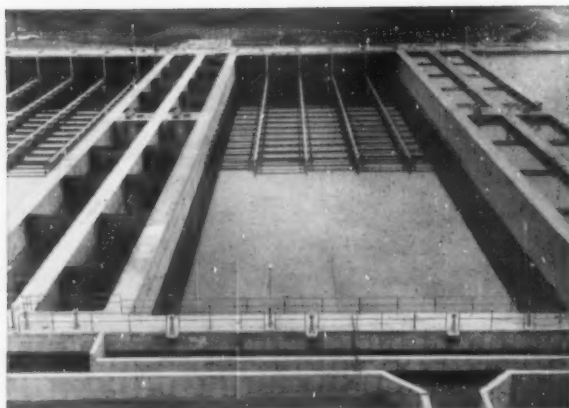
New pipe performance • Prevents leakage • Restores full flow coefficients • Reduces pumping and maintenance costs • Protects against corrosion, contamination and water discoloration... at much less than the cost of installing a new line.

**Note:** Pipe Linings, Inc. lines pipe 16" to 144" in diameter economically too... using the Centri-line Process.

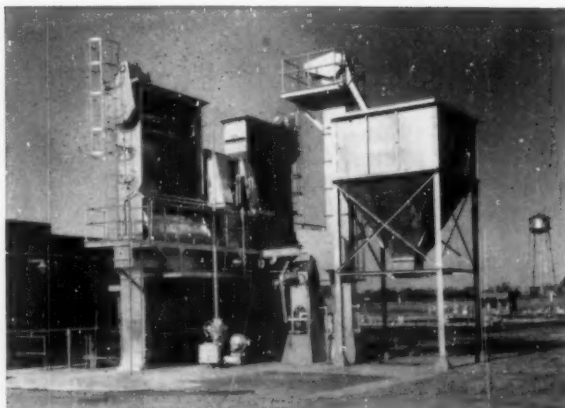
## PIPE LININGS, Inc.

Specializing in Pipe Protection Problems • Interior Cement Mortar Lining • Somatic® Exterior Pipe Protection • Pipe Wrapping • Centrifugal Spinning of Cement Mortar Linings in Plant • Pipe Reclamation

2414 E. 223rd St., Wilmington, Cal. • P. O. Box 457, Wilmington, Cal.,  
Phone NEVada 6-1771 • Rail Address: Watson, Cal.



Jeffrey Floctrols and Sludge Collectors at Big Walnut Filtration Plant, Columbus, Ohio, where Jeffrey also installed Traveling Water Screens, a Bar Screen and Spiral Conveyors.



The White Rock Sewage Treatment Plant at Dallas, Texas has Jeffrey Grit Collectors and Grit Washer, Screens and Screenings Grinder; also Sludge Collectors and Skimmers not shown in this photo.

## HERE'S HELP ON SANITATION PROBLEMS

Hundreds of water, sewage and industrial waste plants are now Jeffrey-equipped. Experienced Jeffrey engineers offer assistance on *your* sanitation problems. The complete Jeffrey line for treatment plants includes:

Apron, Belt, Spiral Conveyors  
Bar and Disc Type Screens  
Biofiltration Plant Equipment  
Bucket Elevators  
Chains and Sprockets  
Dry Chemical Feeders  
FLOCTROLS  
Garbage Grinders

Grit Collectors and Washers  
Power Transmission Machinery  
Rapid Mixers  
Screenings Grinders  
Scum Removers  
Sludge Collectors  
Sludge Elevators  
Traveling Water Screens



These products and their applications are described in a new Catalog 905. For a copy, write to the Sanitation Sales Division, The Jeffrey Manufacturing Company, Columbus 16, Ohio.

MINING • CONVEYING • PROCESSING EQUIPMENT  
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING





**Multiplies Bearing Contact  
Area by SIX... AT LEAST!**

**CHAPMAN'S  
Beamed Waterway  
GATE VALVE**



With Chapman's Beamed Waterway Valve, in the partly open position, you get *six to ten* times more bearing contact surface. That's six to ten times more bearing contact surface than you could get from any other double disc parallel seat or square bottom gate valve. No wonder it leads the preferred list for Filtration Plants, Wash Water Service, or other similar limited throttling use.

Operation is smooth. They seat snugly. There's little or no leakage. Bronze bearing surfaces on beams and downstream discs are rugged. Their long useful life . . . with top-notch performance and lowest maintenance . . . is measured in decades, not just years. This applies to all sizes . . . with any desired method of operation.

Outside of a stamp, it costs nothing to get all the facts. You'll find them in our Catalog No. 45 . . . an informative digest devoted exclusively to Chapman Beamed Waterway Gate Valves.

*Why not write for it . . . now!*

**THE CHAPMAN VALVE MANUFACTURING COMPANY**  
INDIAN ORCHARD, MASSACHUSETTS



**PITTSBURGH, PA.**



**Waste Disposal  
Authorities**

**make sure of "NO JOINT LEAKS" with**

# **TYLOX-JOINTED SEWER PIPE LINES**

"No joint leaks permitted . . ." said engineers and officials who planned new sewers for Upper St. Clair, Pennsylvania, near Pittsburgh. Specifying TYLOX Rubber Gaskets for coupling the pipe was one of the steps they took to help assure leak-proof joints.

Not only did they get water-tight joints throughout the line, but the TYLOX Gaskets "paid off" in yet another important aspect — reduced construction cost. . . . With TYLOX, workmen were able to couple pipe rapidly in spite of flooded trenches, and to eliminate "waiting time" by backfilling laid line immediately.

TYLOX Rubber Joints assure quickly assembled, leak-proof joints for any low head service pipe line, anywhere! And being made of acid-resistant, non-deteriorating rubber, they stay leak-proof for the life of the line. Write for more information if you are not already using TYLOX Pipe Joints to reduce installation cost and lengthen life of your sewerage and drainage projects.

**PROJECT:** New sanitary sewers for Upper St. Clair, Penna.

**ENGINEERS:** M. E. Frye & Associates, Consulting Engineers, Pittsburgh, Penna.

**CONTRACTORS:** Nicassio Construction Company, Pittsburgh, Penna.

**PIPE:** Reinforced concrete pipe with TYLOX Rubber Joints, furnished by Neville Concrete Products Co., Neville Island, Pittsburgh, Penna.

**HAMILTON KENT  
MANUFACTURING COMPANY**

**KENT, OHIO**

**427 West Grant St.**

**ORchard 3-9555**

5040



Connecticut's forward-looking State Highway Department is among those engaged in a comprehensive program of setting up realistic speed zones on today's highways for today's cars.

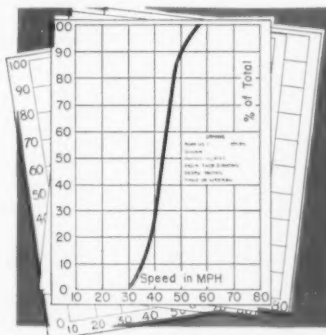
## **ELECTRO-MATIC® RADAR** assures realistic speed limits . . .

The first essential in the process of setting zone speeds is the determination of current speed patterns. The Electro-Matic Radar Speed Meter is now the accepted means by which traffic engineers obtain speed characteristics of vehicle flow on all types of highways.

Highly accurate under all conditions of traffic and weather, it is inconspicuous and operates without contact-making devices on the road surface. The Meter is easily portable and requires only one man for operation. It can be set up in less than three minutes. Operation is on 6 Volt or 12 Volt battery or 120 Volt A.C.

A Graphic Recorder provides a permanent record for study and

analysis leading to the preparation of speed distribution curves and other data essential to instituting a realistic system of speed zoning that goes hand in hand with modern enforcement techniques.



**AUTOMATIC SIGNAL DIVISION**  
EASTERN INDUSTRIES, INC., NORWALK, CONN.

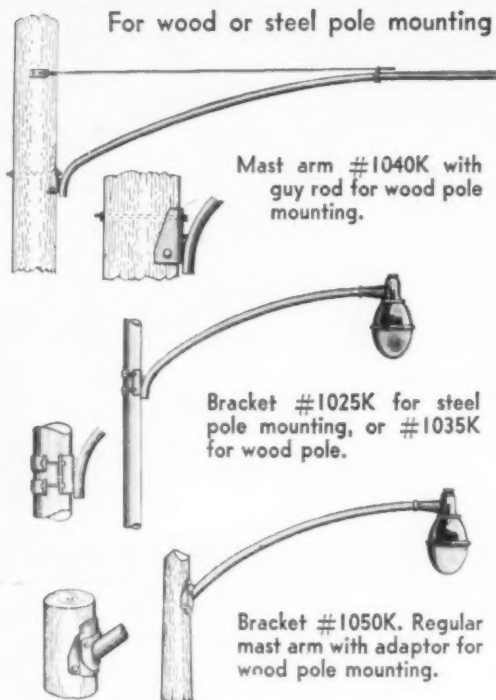
For more information on the Radar Speed Meter, request Bulletin R-112



# KERRIGAN *Weldforged*

## Steel Brackets & Mast Arms

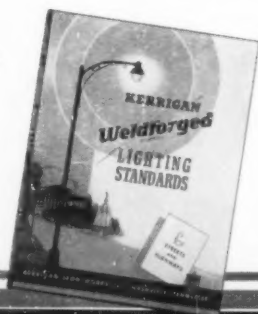
### *For Economy & Beauty*



Kerrigan's complete line of brackets and mast arms are carefully engineered for easy installation and wiring. They meet all I.E.S. street lighting recommendations. So, take advantage of your wood poles now in place and brighten up your city or town NOW!

*Let us help you*

solve your city's lighting problems. Send for our FREE catalog containing engineering data. It shows how simple installation really is.

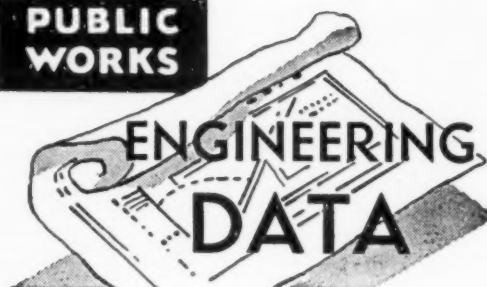


## KERRIGAN IRON WORKS, INC.

Nashville, Tennessee

Gen'l. Sales Office — 274 Madison Ave. — N.Y.C.

## PUBLIC WORKS



### New "Keep Right" Traffic Signs for San Francisco

San Francisco now has a new type of "Keep Right" traffic sign for placement in advance of the street-car loading islands on Market Street. The previous signs, standard R7R's, were being demolished by automobiles at the rate of 5 to 10 signs per month. Field studies indicated that the probable trouble lay with the fact that the reflecting area of the R7R's was relatively small and it had to compete at night time with high intensity illumination from street lights, theater marquees and neon signs on lower Market Street, and so tended to have a low level of visibility.

The new type signs made of wide angle flat top Scotchlite material, mounted on aluminum plate are not only larger but the reflecting area is increased many times over that of the original "Keep Right" sign. The flat surface of the reflective sheeting prevents the accumulation of an excessive amount of dirt on the face of the sign. Experience with these new signs has been very good, only two of them on the entire length of Market Street having been damaged in the period of 11 months since they were erected.

### Combustible Refuse Collection and Disposal In Oak Park

Combustible refuse is collected once a week in Oak Park, Ill. The incinerator is operated twelve hours per day for five days a week by four men. One is on the charging floor and one in the furnace room during the collection period; two report for work at 4 PM, finishing the burning of the combustible refuse and cleaning the furnaces and building. Men working on the collection and disposal of combustible refuse are on a 40-hour week schedule.

Rules governing the disposal of combustible waste delivered to the incinerator specify the hours for disposal as from 8:30 AM to 10:30 AM and from 1 PM to 2 PM; with no disposal on Saturday or during a Village emergency. The charges are: Minimum of \$1.00 per load; 20¢ per 100 lbs. of debris, plus 5¢ per 25 lbs. over 100 lbs.

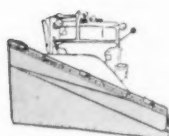
### Annexation Fee of \$2000 per Acre Proposed for New Areas

A new annexation policy is now under consideration by Denver, according to the Toledo City Journal. The policy calls for a fee of \$2,000 per acre for taking new land into the city. The plan was given unanimous approval by the plan commission following a year of study. Purpose of the annexation fee, according to the Denver Post, is to help finance needed capital improvements which follow annexations, such as

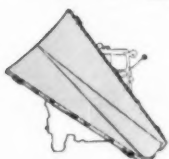


There is only one Roll-Over  
... and it's made by FRINK

## For Airports and Dual Highways



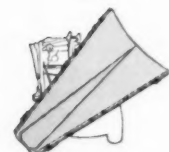
The Frink Taper Blade Roll-Over Sno-Plow combines the advantages of the reversible blade type with higher speed, deeper snow handling qualities of the one-way plow.



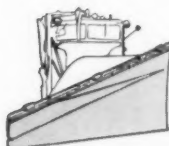
This plow throws and spreads the snow, yet can be hydraulically rotated from left hand to right hand plowing position in 15 seconds, enabling the operator to throw *all* the snow in the most favorable direction as dictated by the wind or the location of the disposal area.



Deadheading is eliminated, therefore, less equipment is needed. Parking is easier, because the truck can be parked with the Roll-Over in the upright position within its own width.



The Frink V-Type, One-Way Type, and Reversible Type Sno-Plows can all be attached to the Roll-Over Lifting Device Assembly.



Clayton, 1000 Islands, New York

Made in Canada by

Frink Sno-Plows of Canada, Ltd., Toronto, Ontario

PUBLIC WORKS for October, 1956



## Another Modern Pool with ADAMS SPF FILTERS

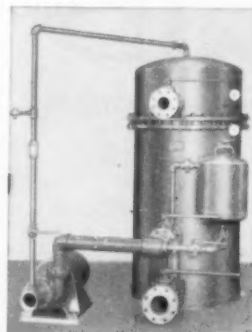
Beautiful Silver Thatch Inn, on Pompano Beach, Florida, offers its guests this lovely pool with underwater picture windows.

YES, here's another distinctive pool with the popular Adams Poro-Stone filters. More and more public pools are insisting on Adams Filters, and there are many good reasons why. Here are two of the important ones.

*First*, the exclusive ADAMS HI-FLOW backwash design gives you simple and easy cleaning . . . no messy disassembly . . . no scrubbing of filter elements. The high air dome and unrestricted backwash outlet provide complete purging of the filter tubes with high velocity water.

*Second*, rugged 4 1/4" O.D. PORO-STONE elements with nearly 40% open area are unaffected by corrosion. The first Adams swimming pool filter — in use since 1938 — was the first Poro-Stone Swimming Pool Filter installed in this country.

There are numerous other reasons why it pays to specify and buy Adams SPF filters. Get all the facts by writing for your copy of Bulletin 625. Use the Handy coupon below.



## R. P. ADAMS CO., INC.

228 East Park Drive  
Buffalo 17, N. Y.

This Adams SPF-129 Poro-Stone Filter keeps the Silver Thatch Inn pool water brilliantly polished for the enjoyment of swimmers and viewers alike. It offers 129 square feet of filter area . . . will handle pools up to 185,000 gallons capacity. It is ideally suited for outdoor pools such as is shown above.

R. P. ADAMS COMPANY, INC.  
228 EAST PARK DRIVE, BUFFALO 17, N. Y.

0-56

Please send me by return mail your new Bulletin 625.

Name.....Title.....

Business.....

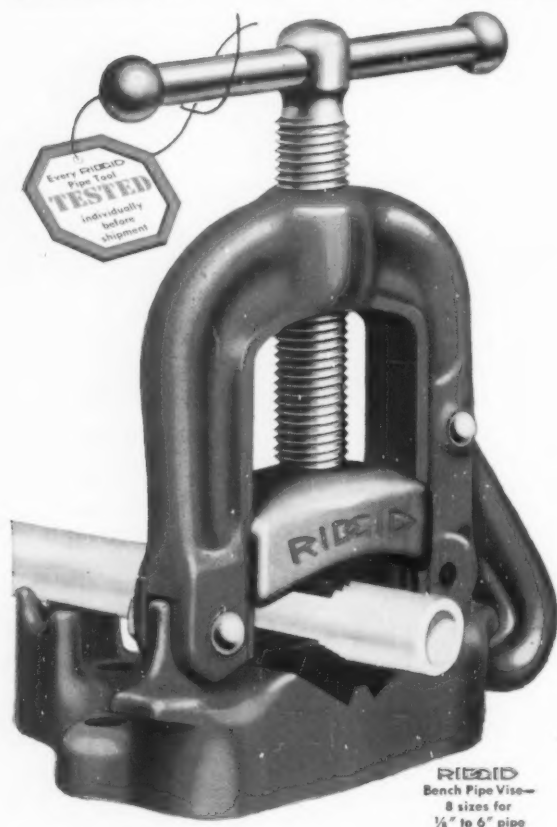
Street.....

City.....State.....

Size of pool is.....gallons.

# Not a Secret Vise!

Known Everywhere As Extra-handly and Rugged



## RIGID

### More-for-your-money pipe vises

**Easy to Work With**—LonGrip jaws for firmer pipe grip *plus* pipe rest for accurate threading and cutting. Built-in handy pipe bender—a time saver . . .

**Years of Service**—Replaceable long-life tool-steel jaws. Yoke and base of special tough malleable . . . Same quality in all RIGID vises, yoke and chain. Order from your Supply House!



The Ridge Tool Company, Elyria, Ohio, U.S.A.

schools, fire and police stations, streets, parks and bridges. The Denver plan commission reported that annexation of raw land to the city now costs taxpayers about \$8,000 per acre to develop into residential area. The \$2,000 fee would off-set one-fourth of this cost with residential property owners paying another fourth. The remaining cost would be borne by business and industrial property taxes, it was reported.

### Tourists in the Great Smoky Mountains

The Highway Commission of North Carolina conducted a survey of the Great Smoky Mountains National Park to determine where the park visitors come from. At the half-way mark of the three-month survey the report showed a total of 51,690 people in 15,000 cars visited the park with an average of 3.44 passengers per car. On week days the report showed that 74 percent of the total motorists interviewed came from the following ten states:

State	Percent
Tennessee	25.8
Ohio	8.9
North Carolina	6.9
Florida	6.5
Illinois	5.6
Georgia	4.7
Indiana	4.5
Michigan	4.1
Kentucky	4.0
Alabama	3.0
Total	74.0

### Sludge is Dried and Used For Soil Conditioner on City Parks

At the Richmond-Sunset plant, San Francisco, sludge is digested in two-stage digestion, elutriated and dewatered by vacuum filtration. During the past year all filter cake was hauled to city parks for use as a soil conditioner. In the future this cake will be hauled to the Southeast plant for final drying. Raw sludge collected at the North Point plant is pumped to the Southeast plant through a 10-inch diameter concrete-lined force main approximately six miles long. The sludge treatment facilities at the Southeast plant consist of raw sludge thickening, two-stage digestion, elutriation, vacuum filtration, and flash drying of sludge. Part of the dried sludge is delivered to the Recreation and Park Department for use in city parks and squares. The balance is sold under contract at a price of \$5 per ton to a prime contractor, except for a limited amount sold at the same price to the Water Department for use in the walnut groves at Sunol.

### Settlement of Sanitary Fill

The height of the sanitary fill used for disposal of San Francisco refuse ranges from 18 to 28 feet above mean sea level. The first layers deposited on the tide flats sometimes settle as much as 5 feet in three days due, in part, to displacement of the underlying mud and, in part, to compression of the garbage. As additional layers are placed the settlement is much slower, averaging about 1 foot per week for the first two weeks, then declining to about 6 inches per week, and finally reaching relative stability after a total settlement of about 8 feet has been reached.

**sewage  
treatment  
plants  
can be  
good  
neighbors,  
too . .**



## **Nichols Herreshoff**

**Multiple Hearth Dryer-Incinerators**

**Nichols Engineering & Research Corp.**

70 PINE ST., NEW YORK 5, N. Y.

1637 N. Illinois St., Indianapolis 2, Ind.

1477 Sherbrooke St. W., Montreal 25, Canada



Can sewage treatment plants be good neighbors? Yes—if the housekeeping is good, and all sewage solids are reduced to ash immediately in Nichols Herreshoff Multiple Hearth furnaces.

As illustrated here, the necessity of building sewage treatment plants adjacent to residential areas is becoming more prevalent. These plants must not offend their neighbors with odors, smoke or fly ash.

Modern Nichols Herreshoff furnaces convert by high temperature combustion all putrescible solids of sewage—grits, grease, screenings and sludge—to clean, innocuous gases and inert ash.

Yes, sewage treatment plants can be good neighbors.

*Illustrated here are two views of the West New York, N. J., sewage treatment plant, Nichols Herreshoff equipped.*

CONSULTING ENGINEER: Frank J. Oleri, West New York, N. J.



# Rock Salt... and Today's Roads

by **INTERNATIONAL SALT COMPANY, INC.**—America's largest producer of salt



## 3-Year Survey Shows Why Rock Salt Is "Best" for Ice, Snow Removal

Early this year, the Civic Affairs Committee of The Engineering Society of Detroit completed an exhaustive study—"The Use of Salt for De-Icing Streets." Over three years of intensive work by 14 outstanding engineers went into this study—which covered representative cities across the country. Their final report is now considered to be the most authoritative ever published on the subject.

Here are some of the highlights of this important report:

**Public safety—and economics.** According to studies made in Detroit, severe winter storms in this city could produce staggering financial losses. Employee lateness would cost \$55 million a year... retail sales would drop \$26 million a year... trucking losses would be \$7 million annually... and this does *not* take into account huge losses from accidents, damage, decreased factory output, etc.

However, the use of rock salt in Detroit for immediate removal of ice and snow *prevents* these losses from occurring. And at very little expense, compared to the economic benefits to the community. For these reasons, The Civic Affairs Committee concludes: "... use of rock salt is by far the best procedure, and is in the best public interest. ... It is a 'modern' program geared to the problem of keeping an urban community operating in spite of adverse winter weather."

**Effect of rock salt on cars.** Studies were made in 12 different states in order to determine corrosive effects of rock salt on car bodies, bumpers, fender welts, etc. (The three major automo-

tive manufacturers were represented on the Committee in this work.) According to the evidence collected, The Civic Affairs Committee states, "The enamels and lacquers used on autos today are relatively unaffected by salt used on the street to melt ice and snow. Only when the finish is broken in some manner, allowing the brine solution to reach the underlying steel, will corrosion start."

**Corrosion inhibitors.** The Civic Affairs Committee also investigated so-called corrosion inhibitors. Their findings indicated: "... the use of inhibitors in salt is of doubtful value in protecting the exterior appearance of autos." It was also reported that "inhibitors are unable to prevent corrosion of susceptible parts of autos."

**Effect of rock salt on utilities** and other structures. In this study, the Detroit Edison Co. and the Michigan Bell Telephone Co. presented evidence to show that the economic benefits of using rock salt far outweighed any effects it may have on their equipment. "In general... the problems of the electric utility are not measurably increased by use of salt in de-icing streets." Also, the effect of salt on telephone utilities "appears to be of a low order of magnitude and is readily handled by normal maintenance procedures."

As far as street or highway surfacing is concerned, these general observations were made: Rock salt does not harm black top (bituminous and asphalt), natural stone, and air-entrained cement surfaces.

### STERLING SALT FOR ICE AND SNOW CONTROL

When you set up this winter's program for ice and snow control, be sure to check with International Salt Company—makers of famous Sterling Rock Salt. One of International's skilled and experienced "Salt Specialists" will help you set up an effective, low-cost pro-



JUST 7 MINUTES after Sterling Rock Salt was applied—this U.S. Highway is clear and open! Traffic is moving safely despite the snowfall. On this highway—as on many others—tests have shown that just one truckload of Sterling Rock Salt covers as long a stretch of road as five truckloads of abrasives. And with this rock salt, spring cleanup expense is eliminated.

gram for *your* roads and streets. He'll show you actual examples of how Sterling Rock Salt has worked to speed removal of snow and ice. And he'll give you complete details on ordering, storing, and applying this quality salt product. Just contact your nearest International sales office.

**IMPORTANT NEWS:** Now you can store your rock salt outdoors—and still have it free-flowing when winter storms hit! A newly developed chemical agent, Sterling *Storite*, actually prevents rock salt from caking. It eliminates the need for costly structures to protect salt from weather... permits economical early ordering. Amazing new *Storite* is low in cost, easy to apply. Be sure to specify Sterling *Storite* with your order of Sterling Rock Salt. It's available now—shipped in 50-lb. drums.

**Sales Offices:** Atlanta, Ga.; Chicago, Ill.; New Orleans, La.; Baltimore, Md.; Boston, Mass.; Detroit, Mich.; St. Louis, Mo.; Newark, N. J.; Buffalo, N. Y.; New York, N. Y.; Cincinnati, O.; Philadelphia, Pa.; Cleveland, O.; Pittsburgh, Pa.; and Richmond, Va.

**FREE COPY** of the complete Civic Affairs Committee report—"The Use of Salt for De-Icing Streets." A *must* for every official concerned with highway safety, traffic, maintenance—and practical economics. Fully documented, with graphs, charts, references. For your copy, write International Salt Co., Scranton 2, Pa.

FOR ROADS, INDUSTRY, FARM, AND HOME—

## STERLING SALT

PRODUCT OF INTERNATIONAL SALT CO., INC.





## 200,000,000 Feet In Service Today!

# ORANGEBURG®

### ROOT-PROOF PIPE AND FITTINGS

Over 200,000,000 feet of Orangeburg Pipe are in service today from Maine to California. Its recorded use in sewage disposal work dates back to 1906.

Orangeburg's root-proof joints and its resistance to corrosion make the pipe particularly adaptable for house sewers and other underground non-pressure uses.

Through its record in actual service, Orangeburg has gained acceptance by leading approving authorities, architects, engineers, plumbers and builders.

Outstanding quality is the big reason. Orangeburg is strong, tough, resilient . . . withstands traffic tensions . . . temperature changes. Resists acids and alkalis in ground waters and sewage wastes . . . lasts for years underground.

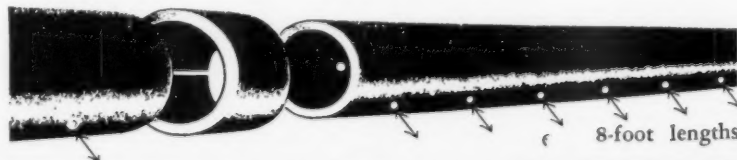
Orangeburg makes quick work of installation. Light 8-foot lengths are easy to handle. Taperweld Joints seal root-proof without cement or compounds.

Write Dept. PW-106 for Engineers' independent report on Orangeburg Sewer Pipe.

ORANGEBURG MANUFACTURING COMPANY, INC.  
ORANGEBURG, N. Y. West Coast Plant: NEWARK, CALIF.

### ORANGEBURG Also Comes Perforated

for foundation drains, septic tank disposal fields, subsurface drainage of lawns, fields, wet-spots everywhere. Snap couplings keep pipe in line. Scientifically spaced perforations assure uniform seepage.



### THESE EXCLUSIVE ORANGEBURG FITTINGS SIMPLIFY INSTALLATION

1/8  
BEND



TEE



WYE



1/4  
BEND

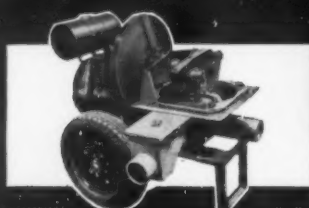


# THE NATION'S No. 1 SOURCE

for dependable pipe line equipment

Like hundreds of Pollard customers, you'll find it mighty pleasant and convenient to order pipe line equipment from Pollard.

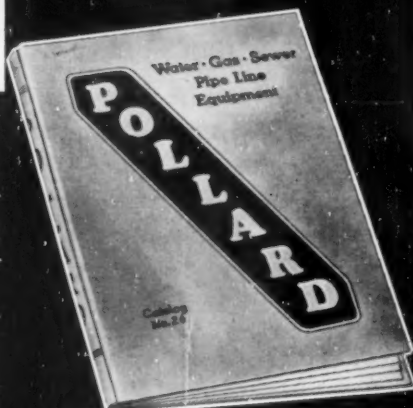
Here, under one roof and listed in one comprehensive catalog, are all the time and money saving products you need on the job. Each is guaranteed for dependability, economy. Each is backed by Pollard service.



DIAPHRAGM PUMPS



PIPE CUTTERS



M-SCOPE PIPE FINDER



MELTING FURNACE



JOINT RUNNERS



MANHOLE CUSHION

MAKE POLLARD YOUR  
SOURCE FOR PIPE  
LINE EQUIPMENT.  
ORDER FROM  
POLLARD CATALOG 26.



CALKING TOOLS

PIPE LINE EQUIPMENT

**JOSEPH G.  
POLLARD  
CO., INC.**

PIPE LINE EQUIPMENT

Place your next order with POLLARD

If it's from POLLARD . . . It's the Best in Pipe Line Equipment

NEW HYDE PARK • NEW YORK

Branch Offices: 1064 Peoples Gas Building, Chicago, Illinois  
333 Candler Building, Atlanta, Georgia

# GREAT NEW IDEA in tractors and attachments



52 hp

**Model 404** with 3/4-cu. yd. loader works as primary equipment . . . as backup machine . . . as utility or cleanup tool. Tractor is available with either gasoline or diesel engine.



**M-H-F**

## WORK BULLS

Now from one source . . . a package of 5 versatile, low-cost tractors with 20 power-matched attachments

Caught in the squeeze between soaring demands for service and the cost of labor and equipment? Work Bulls provide an answer. Work Bulls pay off as primary equipment . . . as backup machines . . . as utility or cleanup tools.

For an unusually small investment you can put a Work Bull on your job—use it to dig, doze, load, lift and handle scores of other assignments. Attachments can be switched in less time than it takes for a smoke break.

And Work Bulls go anywhere, work anywhere . . . keep busy day long, year round. In the off-season,

Work Bulls continue to earn their keep plowing snow, hauling wagons, maintaining coal and other stockpiles or working around the yard as fork lifts.

What's more, Work Bulls are built to "construction standards"—tough, rugged and ready to give you years of service with only routine maintenance. Remember, with Work Bulls you deal with only one source for sales and service on both tractor and attachments.

Why not ask your retail distributor to demonstrate how a Work Bull will pay off for you. Write for his name and a free, 24-page catalog.

## M-H-F WORK BULLS

Division of Massey-Harris-Ferguson, Inc.

16-J Quality Avenue • Racine, Wisconsin

PUBLIC WORKS for October, 1956



42 hp

**Model 303** with angle-dozer and rear-mounted backhoe provides ideal means to clean up after main-line or intermediate machines . . . keeps equipment costs relative to job.



34 hp

**Model 202** and backhoe — 5 sizes, 12" to 36" buckets. Swings 180°. Ideal for scattered "work and run" jobs — anywhere. Digs to depth of 13 ft.



42 hp

**Davis Pit Bull** features torque converter . . . "foot-shift" direction changes . . . five speeds forward, five reverse. Frequently out-works more expensive, single-purpose rigs.



Fork Lift

**Model 202** lifts 4000 lbs. with 10 ft. mast, has extension with 21 ft. reach for lighter loads.



## New **HOMELITE** Pump *Whispers While It Works*

Goodbye residential complaints! Here's a new light-weight gasoline engine driven pump that takes it easy on the neighbors' ears. Yet handles any water problem . . . from seepage to volumn pumping! The new Homelite Model 36 S2 2" self priming centrifugal Pump operates at slow speed with low noise level yet has high capacity of 9000 gallons per hour. It weighs only 85

pounds and can be easily carried by one man to the best pumping location. Starts quickly, primes automatically, gives long, dependable and trouble-free service under the toughest conditions. Ask your Homelite Representative for a free demonstration. You'll find a good neighbor policy in every pump.

### **HOMELITE**

a division of Textron Inc.  
2110 RIVERDALE AVENUE • PORT CHESTER, N. Y.  
Canadian Distributors: Terry Machinery Co., Ltd.  
Toronto • Montreal • Vancouver • Ottawa • Edmonton • Moncton



# LEGAL ASPECTS OF PUBLIC WORKS

**MELVIN NORD,**

**Dr. Eng. Sci., LL. B.**

Registered Professional Engineer

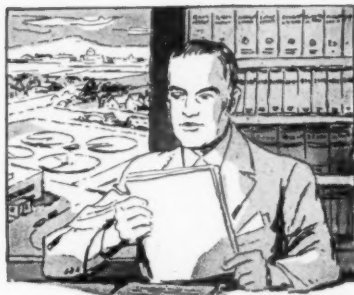
## No Water Right When No Water Left

In the case of *Mongiello v. Hightstown*, 17 N.J. 611; 112 Atl. (2d) 241, a New Jersey case decided March 14, 1955, a housing development builder sought to compel an adjoining borough to supply her houses with water. The borough had previously extended incidental water service to a small number of adjoining non-residents who could conveniently connect with borough mains at its borders, and in a spirit of cooperation with a turnpike authority it had agreed to supply water, through a main constructed by the turnpike authority and transferred to the borough, to certain non-residents whose wells had been destroyed by the construction of the turnpike. The borough refused to supply plaintiff with water because their water facilities were already operating near capacity.

The plaintiff's suit was based on the theory that when a municipality operates a water system, it is a public utility and therefore is not permitted to refuse service to persons situated similarly to others whom they do serve.

The court refused to grant the plaintiff any relief, however, on the ground that the borough had no absolute duty to serve non-residents, and that there was no arbitrary discrimination. Obviously, voluntary extensions of service to non-residents cannot be ordered without limit.

The general subject of the right to compel a municipality to extend its water system is annotated and discussed in 48 A.L.R. (2d) 1222. The cases in other jurisdictions show that a municipality cannot be required to extend facilities it has voluntarily established outside its borders unless: (1) it has con-



tracted to do so, (2) it has held itself out as a public utility in such area, and it is guilty of improper discrimination. Neither of these factors were present in the case cited, and therefore the decision is clearly in accord with authority in other jurisdictions.

## The New Swimming Hole

*Orrison v. City of Rapid City*, 74 N.W. (2d) 489, a South Dakota case decided Jan. 30, 1956, was an action by a patron of a municipal swimming pool for injuries sustained when she stepped on a broken bottle in the dressing room.

The jury gave her a verdict of \$1000, and the City (that is to say, the City of Rapid City) appealed. Among other things, it was claimed that the City of Rapid City, as a City, was immune from suit.

The holding of the appellate court, however, was that even though the City of Rapid City might be a City, it still did not have the immunity of a City, because the operation of a swimming pool is a proprietary function rather than a governmental function. This was so even though the City offered to prove that it was losing money on the operation of the swimming pool. Since it was found by the jury that the City of Rapid City had been negligent in its operation of the dressing room, the City was liable.

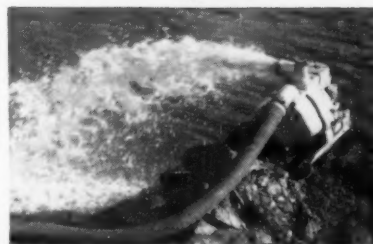
As a result, the City of Rapid City is losing even more money than usual this year.

## Municipal Liability for Nuisance

*Lemkuhl v. Junction City*, 295 Pac. (2d) 621, a Kansas case decided April 7, 1956 presents a gruesome reminder to municipalities that they are not immune from liability all the time.

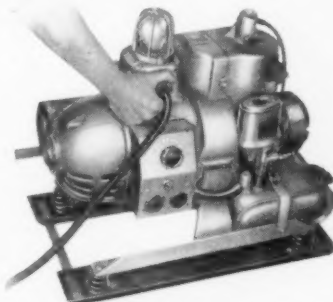
In Junction City, Kansas, there was a hole 100 feet wide which was filled with water to a depth of 18 feet. The City had control of it and at one time had used it as the city

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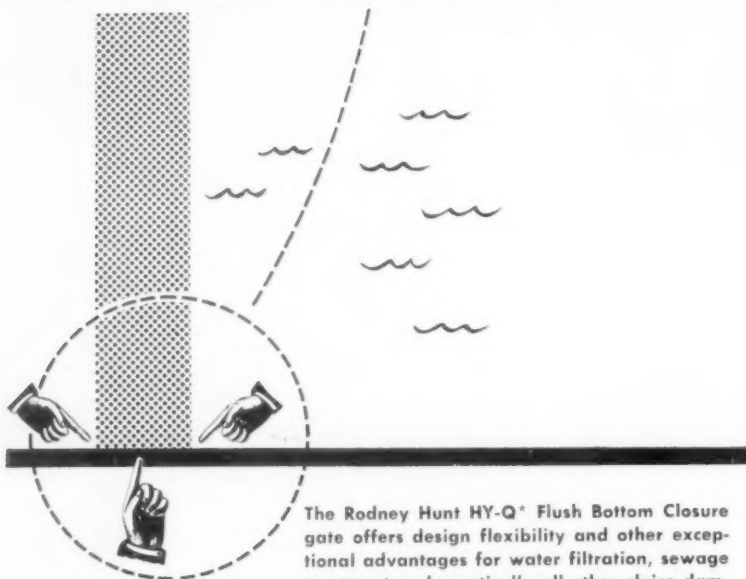
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# the **HY-Q** Sluice Gate

seats flush on the bottom of the channel!

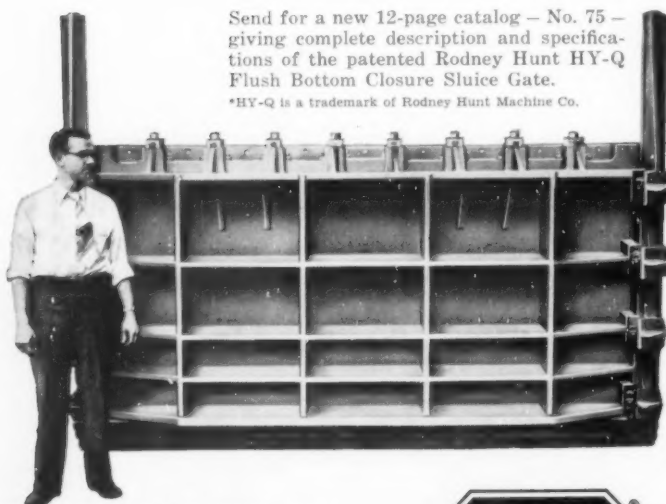


The Rodney Hunt HY-Q® Flush Bottom Closure gate offers design flexibility and other exceptional advantages for water filtration, sewage treatment and practically all other sluice dam, channel and chamber flow control.

- ① You get maximum flow because there is minimum turbulence at the point of greatest head.
- ② You get *complete* drainage naturally; no need for pumps and piping to get out water trapped behind a sill.
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Send for a new 12-page catalog — No. 75 — giving complete description and specifications of the patented Rodney Hunt HY-Q Flush Bottom Closure Sluice Gate.

\*HY-Q is a trademark of Rodney Hunt Machine Co.



**RODNEY HUNT MACHINE CO.**

Water Control Equipment Division  
82 LAKE STREET, ORANGE, MASSACHUSETTS, U.S.A.



dump. Trash, junk, and debris had been dumped by the City into the hole without draining the water from it. By reason of the manner in which the refuse was deposited in the hole there was formed across the surface of it a crusty layer of materials, giving the impression it had a solid superstructure, when in fact its substructure consisted of stagnant water and loose material that was incapable of supporting anyone and was in fact a trap for an unwary person who might try to walk across it. The hole was within 100 feet of a city street and was not posted as being dangerous.

As might have been anticipated, two boys, 3½ and 4 years old, walked on the surface, it collapsed beneath their feet, and they were drowned.

In a suit by their parents against the City for wrongful death, the City's defense was that they were immune from such tort actions, because the maintenance of a public dump is a governmental act. The court properly held, however, that the immunity of a municipality for its governmental actions does not extend to cases where they amount to a nuisance. Since this was clearly a nuisance, the City's defense was overruled.

According to McQuillin, "The Law of Municipal Corporations," 3d Ed., Vol. 18, Sec. 53.49, municipal corporations have the same liability for maintaining a nuisance as an individual has, provided the activity is within the scope of the powers of the municipality. The author cites a number of cases similar to the one discussed above.

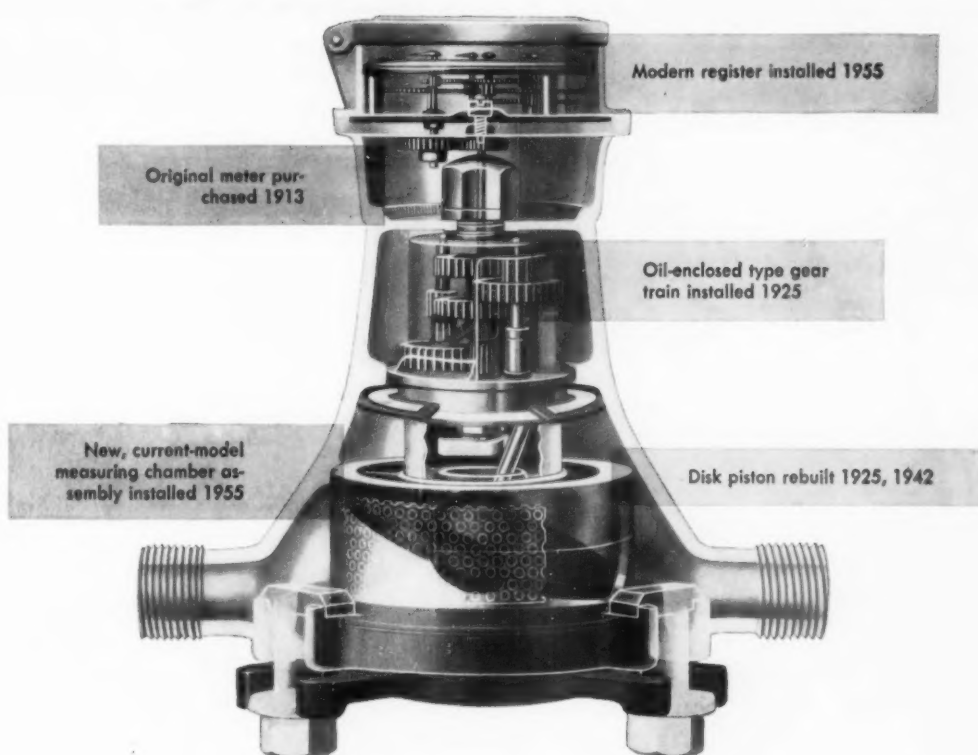
## Report of Ohio Turnpike Commission

The first seven months operation of the Ohio Turnpike in 1956 showed that the gross income totaled \$7,940,829.34. This included money from tolls, service station and restaurant concessions and other means. The operating expenses for this period totaled \$2,169,301.06. The number of passenger cars traveling the toll road was 4,504,116 while the trucks numbered 784,666.

## Cost of Guniting the Interior of a Sewer

Repair of a sewer in San Francisco was accomplished by guniting the interior. A ¾-in. thickness of gunite was placed for a length of 463 ft. at a cost of \$1.04 per sq. ft. of interior surface. The size of the sewer was not reported.

PUBLIC WORKS for October, 1956



## How **NEW** is this Meter?

It was built in 1913 . . . but it's almost as new as 1956. Over the years, working parts have been replaced. Its performance matches every standard of modern metering practice.

The parts used to repair this meter at its last overhaul are identical to those used in the latest Trident meters. They embody every thoroughly tested advancement known to the science of metering.

Designing modern parts to fit "old" meters has been a rigid Neptune policy for over 50 years. It is just one of the extra advantages that make Tridents a better buy . . . both for today and for the years to come.

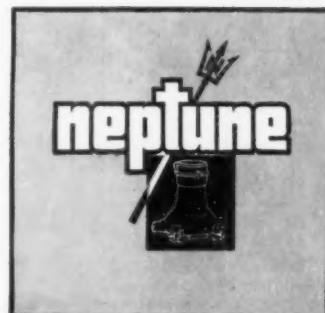
### NEPTUNE METER COMPANY

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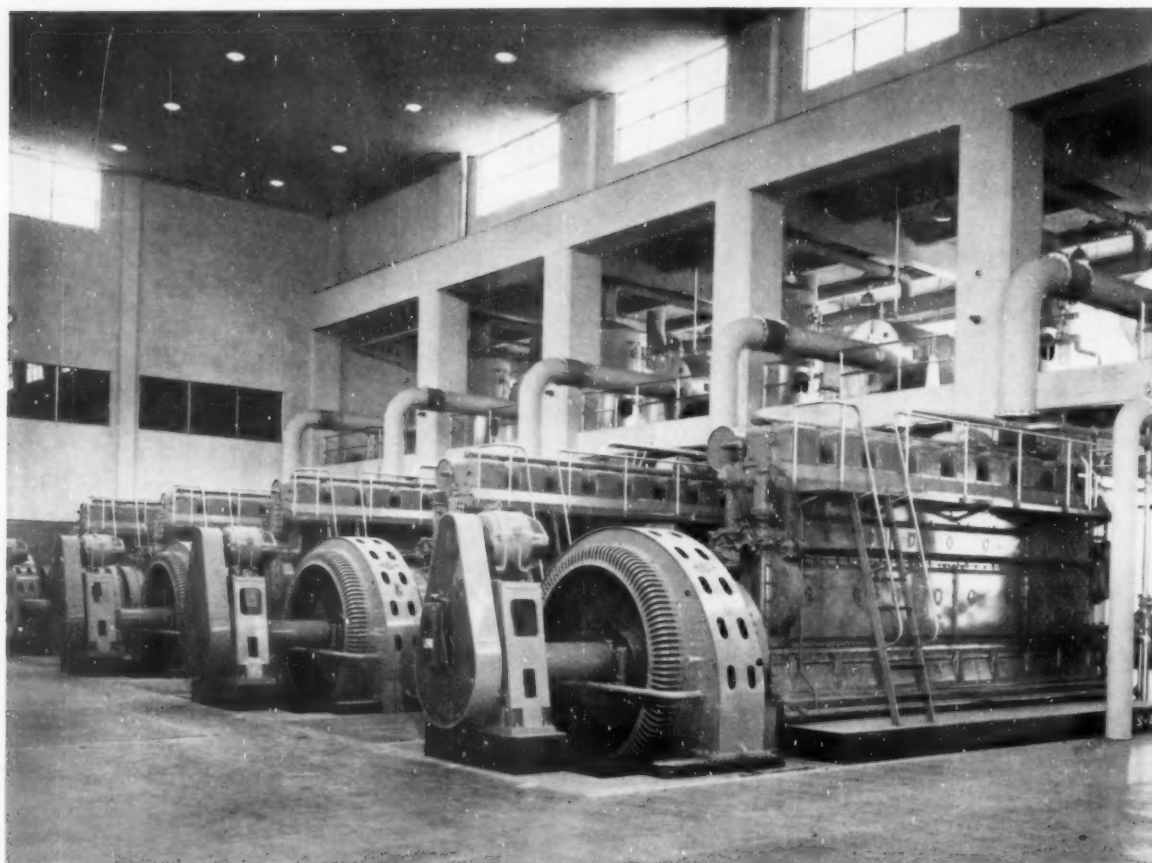
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**"One of the most outstanding operational records in sewage treatment and engine operation" reports Diesel Progress about the Hyperion Activated Sludge Plant of the City of Los Angeles.**



## 10 Worthington engines chalk up 293,899 hours and not one ring, liner, or bearing wore out!

ENGINE	OPERATING HOURS
No. 1	28,928
No. 2	31,163
No. 3	26,926
No. 4	30,422
No. 5	25,648
No. 6	34,472
No. 7	38,367
No. 8	33,785
No. 9	33,753
No. 10*	10,435

\*Installed Oct., 1954

*In six years of operation, the nine original Worthington engines averaged over 31,000 hours each.*

Operating on methane produced in Hyperion's digestion facility, the Worthington engines are turbocharged dual-fuel units rated at 1688 hp each. In six years the ten engines have run 293,899 hours without wearing out a piston ring, cylinder liner, or bearing.

### No. 7 Good for 100,000 Hours

Engine No. 7, first on the line, is typical. This engine has 38,367 hours on its original rings. After a routine overhaul, Hyperion engineers predicted a life of 100,000 hours—equivalent to 11 years of continuous operation—per set of rings. They expect double this life for the cylinder liners.

### Good Operation

Of course, the finest piece of equipment

would not give such an outstanding record without careful attention to such items as lubrication, clean fuel, temperature control, etc. Good operation is the watchword at Hyperion and annual overhauls, including checking of all operating parts, back up the high quality of the Worthington equipment.

### Full Report Available

If you would like a reprint of "Hyperion's Six Years of Operation," an interesting article about the plant and its many maintenance innovations, please write to Section W63, Worthington Corporation, Harrison, N. J. Ask for Bulletin RP-928. In Canada: Worthington (Canada) 1955, Ltd., Toronto, Ont.

W.6.3

# WORTHINGTON



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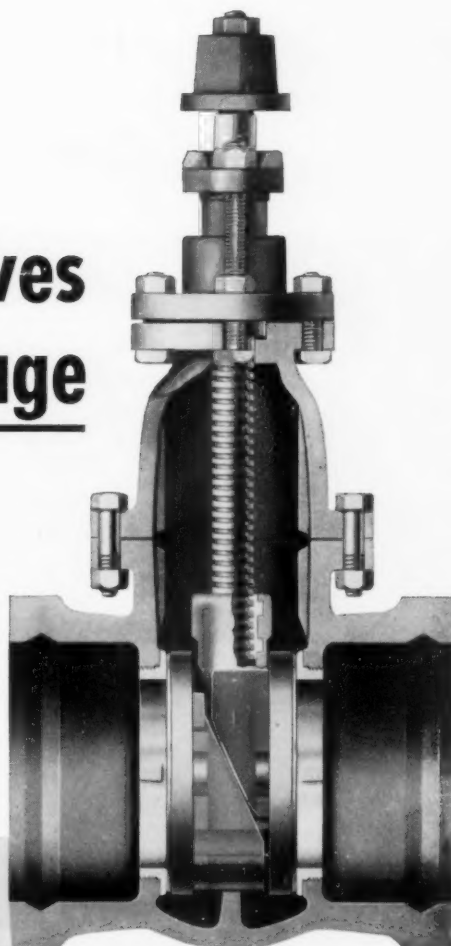
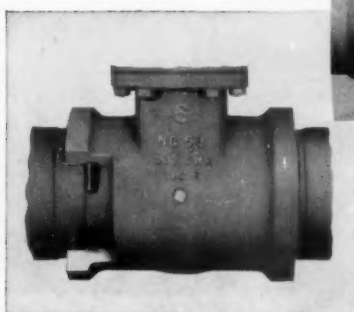
PUBLIC WORKS for October, 1956





# water works valves offer a 3-star advantage

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*Above: Cutaway of Darling Water Works Valve showing unique fully revolving double disc parallel seat principle, noted for long life, minimum maintenance and drop-tight closure.*

*Left: Mechanical Joint and Ring-Tite joint . . . just two of the various valve ends available on Darling Valves.*

**D**ARLING'S topmost quality plus the Darling *fully revolving double disc parallel seat principle*, gives you an unbeatable combination.

The cutaway view shows Darling's simple gate arrangement with its plain no-pocket discs and wedges. These unique features, greatly lengthen disc and seat life, minimize

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Conforming to A.W.W.A. specifications and available in sizes for your particular service, these valves are equipped with ends designed to meet your installation needs.

That's what we mean by a 3-star advantage. For detailed facts, send for Bulletin 5403.

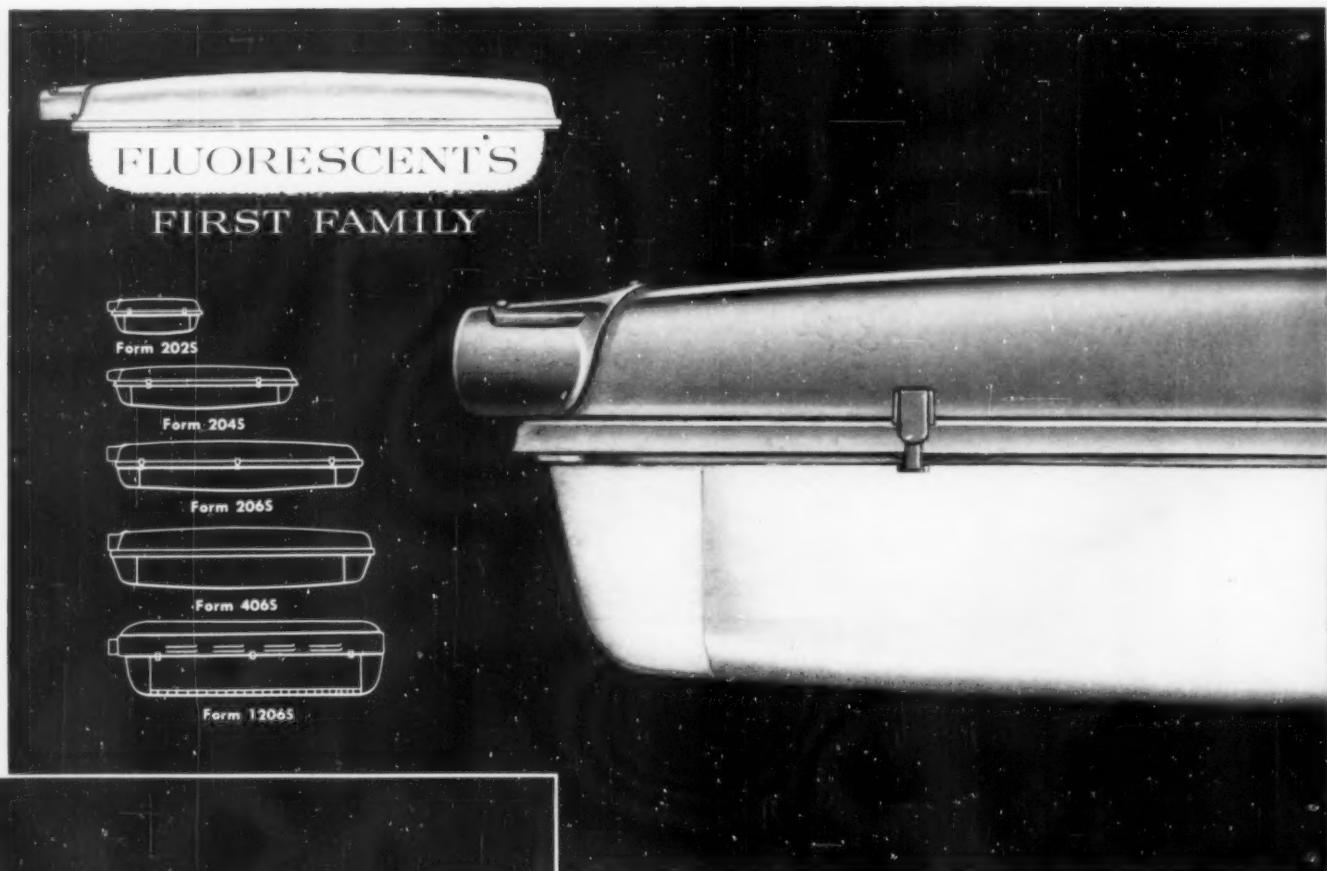
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*Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.*

# New G-E form 204S Fluorescent

## improves visibility, promotes safety in



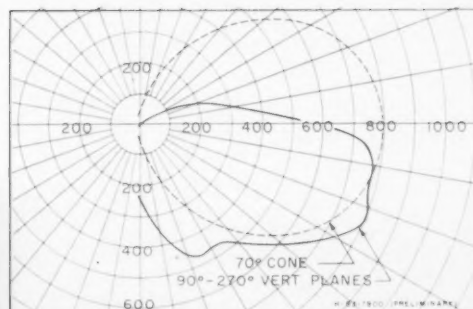
**APPEARANCE PROBLEMS** of satisfying both residential and business desires, without sacrificing the primary object of better street lighting, are easily solved by the modern appearance these luminaires give to any location.

The new G-E Form 204S Luminaire (6600 lumens) is designed to meet the needs of residential areas surrounded by light business and light traffic streets. The dangers associated with automotive and pedestrian traffic are as obvious as the importance of good street lighting. The soft diffused light over a wide area makes it easy for pedestrian and driver to see each other—minimum luminaire brightness practically eliminates glare. In addition, fluorescent lighting gives exceptional uniformity of pavement brightness—even when pavements are wet. This means greater safety and fewer accidents.

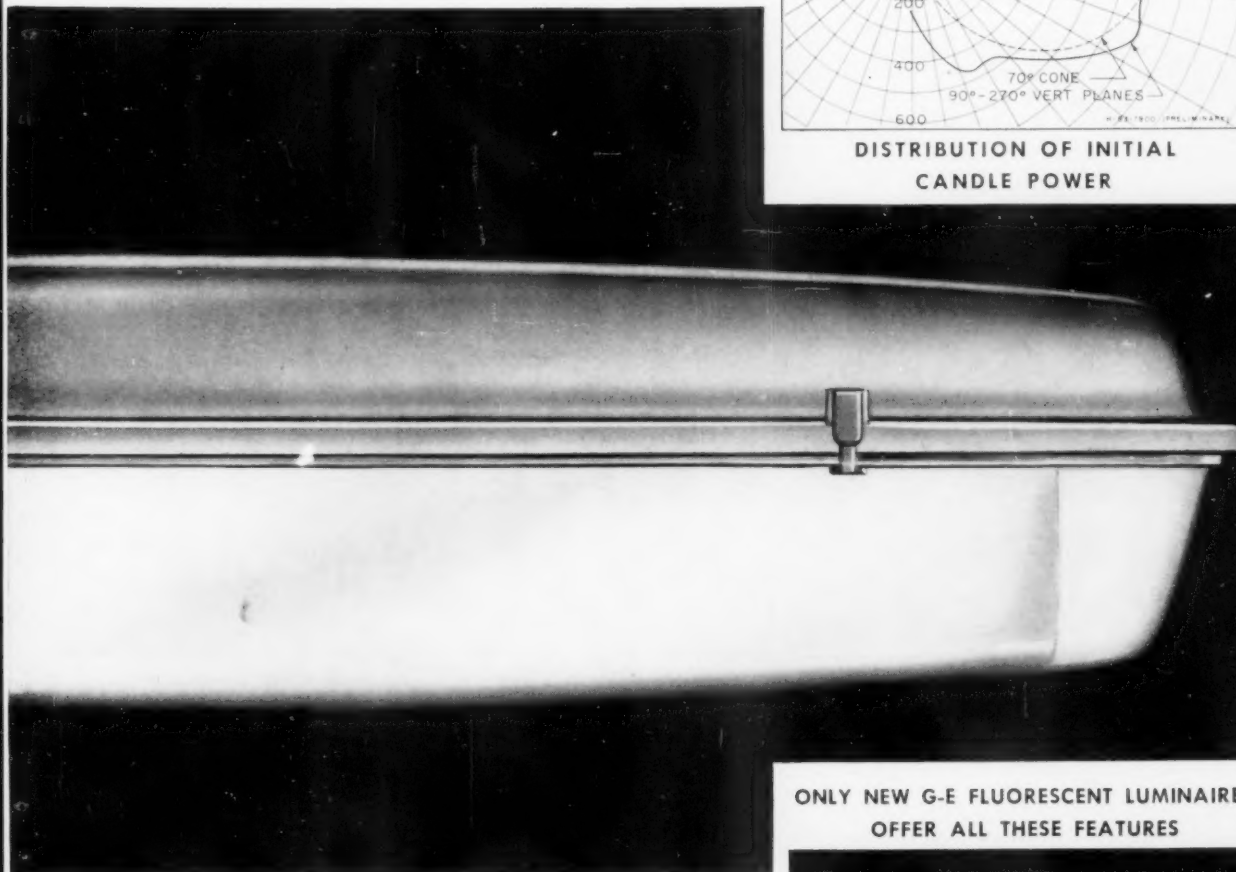
The **Form 204S luminaire** is another member of G.E.'s revolutionary family of fluorescents, now making it possible to bring all the advantages of this type of street lighting—better visibility, more comfortable seeing, lower maintenance—to every street in the community. It's a development made possible by a co-ordinated design of luminaires, lamps, ballasts and brackets for outdoor service. And each member of this family—whether it's the 202S (2700 lumens), 204S (6600 lumens), 206S (10,600 lumens), 406S (21,200 lumens) or 1206S (64,000 lumens)—contains many

# Luminaire

## secondary traffic areas



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new structural design improvements to assure installation, operating and maintenance advantages. Some of these advantages are slipfitter mountings, weatherproof engineering, one-piece side-hinged globe, detachable reflector, pre-wired terminal board, integral ballasts and new, recessed, double-contact-base lamps.

For more information on the outstanding new General Electric Form 204S or any other member of "Fluorescent's First Family," contact your nearest G-E Apparatus Sales Office, or write Section 452-163, General Electric Company, Schenectady 5, New York.

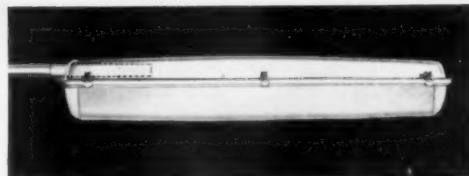
"Out of Darkness," a dramatic 16-mm sound film on how one community met and solved its street lighting problems, is available from your nearest G-E Apparatus Sales Office.

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PUBLIC WORKS for October, 1956

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**Huntsville, Alabama—**

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## ***CAST IRON PIPE***

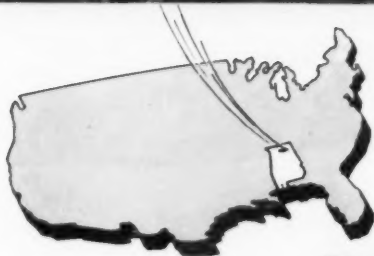


Historic Huntsville, Alabama — rocket and guided missile development center of the U.S.A. — is one of the nation's 60 cities with Cast Iron water mains laid over a century ago. Completed in 1838, they are still giving dependable service.

Modern Huntsville is a thriving city with a "zooming future." Establishment of the Redstone Arsenal and location of many new enterprises have necessitated a major waterworks expansion.

Due recognition of the long and satisfactory service of Cast Iron Pipe in Huntsville was given by its City Council when it purchased 13,000 tons of new Cast Iron Pipe for this project.

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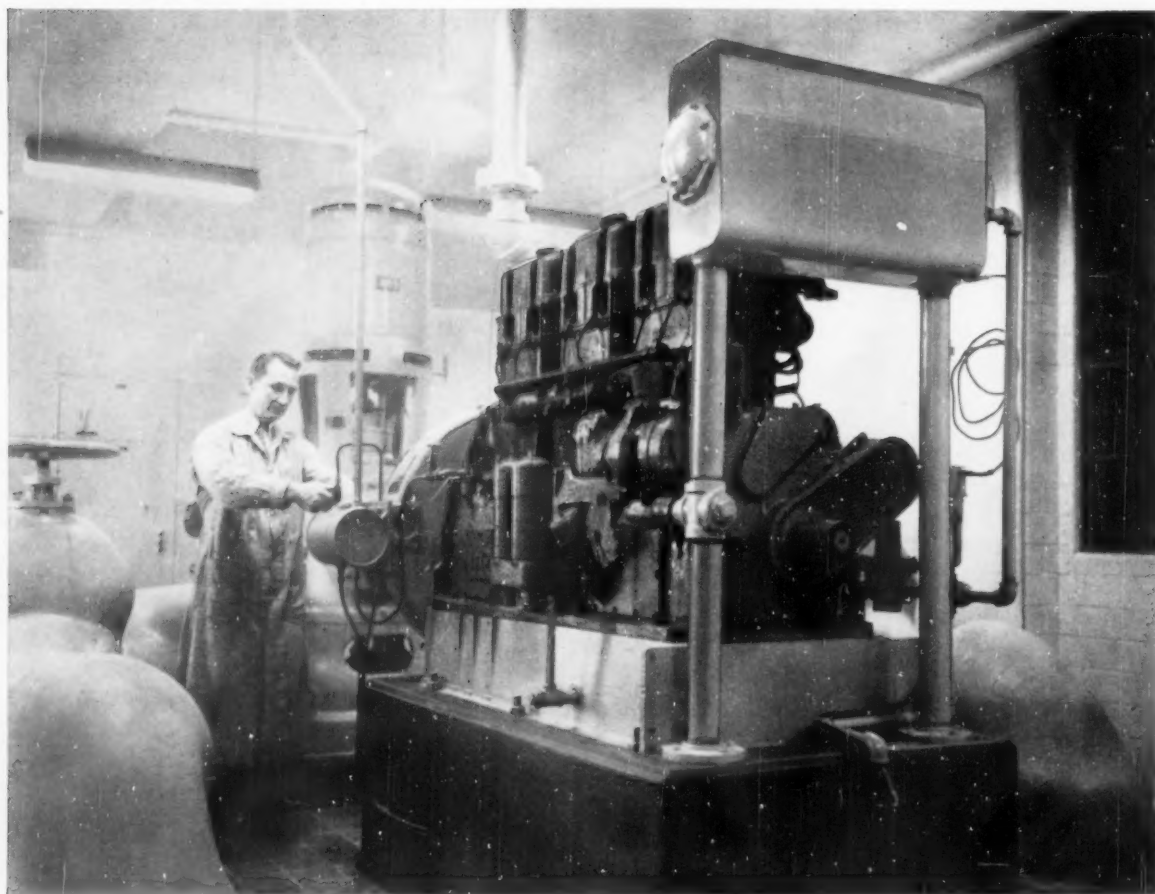
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*Our Company does not manufacture Cast Iron Pipe, but produces quality iron from which quality pipe is made by many of the nation's leading foundries.*

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E-108

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Throughout the country more and more communities are relying on water mains of K&M Asbestos-Cement Pipe...made of asbestos fiber and portland cement. It resists corrosion, is non-electrolytic, two of the many advantages which make for durability.

*Pumping costs low and stable!* There is no clogging to reduce flow and increase pumping costs with K&M Asbestos-Cement Pipe. It is non-metallic... non-tuberculating. Its bore remains smooth and clean.

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## It's Transite Ring-Tite Pressure Pipe

• Transite® Ring-Tite® Pressure Pipe is a community investment that pays off year after year!

Its remarkably high flow characteristics protect that investment by keeping maintenance and pumping costs at a minimum during its long service life.

### **Corrosion Resistant**

Transite Pipe is strong, durable, and highly resistant to corrosion. And it is immune to tuberculation, the form of interior corrosion that chokes the flow and increases pumping costs. Transite cannot tuberculate, thus its original high flow capacity is maintained, and pumping costs are kept at a minimum year after year.

The Ring-Tite Coupling, with rubber rings compressed and locked in place forms a joint that is tight yet flexible. Rings cannot blow out, and the automatic separation of the pipes within the coupling helps to relieve line stresses.

For further information about Transite Pressure Pipe and the Ring-Tite Coupling, write for Booklet TR-160A. Address Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.



**Johns-Manville TRANSITE PRESSURE PIPE**  
WITH THE **RING-TITE** COUPLING





AT EACH of the six Jones Company plants, Chlorine is received in tank cars, repacked in smaller containers selected to meet the customer's needs.

## Save storage space and shipping time on your next **CHLORINE** purchase!

**GET FAST DELIVERY ON MANY CHLORINE PRODUCTS  
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Stop the cost and nuisance of storing huge amounts of Chlorine. Buy only what you need—whether it's several carloads, just part of one tank car, or as little as 16 lbs.!

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We supply more municipalities than all other Chlorine packers combined.

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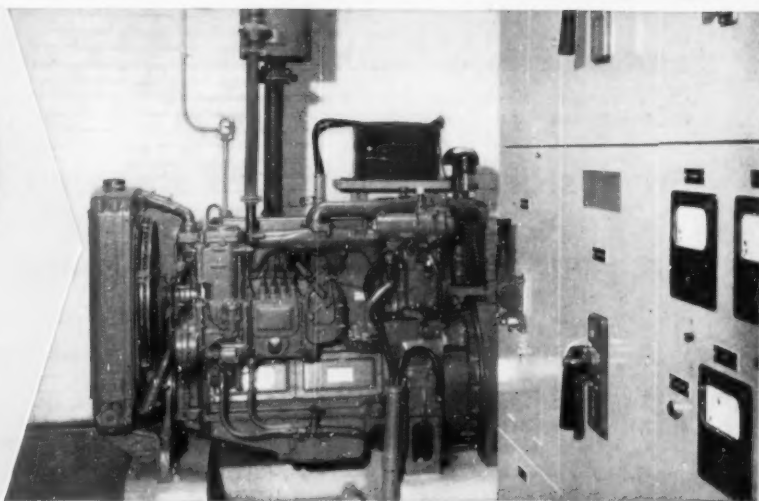
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PORT WASHINGTON, N. Y., with a population of 25,000, started construction of its modern sewage disposal plant in 1951. It went into full operation in April, 1952. The system used is of the Bio-filtration type, and the plant consists of two primary clarifiers, two rapid rate trickling filters, two secondary clarifiers and primary and secondary digester tanks. Total capacity is 3,000,000 gallons per day.

Even before the plant was ready, the Port Washington Sewer District installed a Caterpillar D315 Electric Set as standby power. In four years the unit has twice been called on to supply power to the sewage plant. On one occasion a storm cut off power-line current for six hours. The other time a line break interrupted service for three hours. *But the flow of sewage through the plant never stopped.*

Ralph F. Thomas, Chief of Operations, says: "It's good insurance to keep the plant operating efficiently, with no interruption in the treatment during times of power failure."

Any municipality that neglects insuring the operation of its sewer and water systems with dependable standby power

is risking a heavy loss—possibly costing far more than the standby unit. Electric Sets built by Caterpillar are specially designed for this use. They are self-regulating, require a minimum of maintenance, and they're available with either manual or automatic starting, ready to pick up the power load in a few seconds.

Your Caterpillar Dealer can help your engineers plan the right type of installation for your needs. He has CAT\* Diesel Electric Sets in a full range of sizes up to 350 KW. And his parts and service facilities are at your disposal day or night.

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**MODERN DIESEL  
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# BOND RATINGS and BOND PRICES

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FROM TIME TO time over each generation or so, most cities and towns have passed through a period of locally depressed business conditions when the "city fathers" feel compelled to pare expenses to the bone to hold the tax load as low as humanly possible. Ordinarily, however, American municipalities are not content to lie quiescent; they are impelled to improve and enlarge municipal facilities in tune with the rising standards of living which their citizens are experiencing as individuals. Today's adults almost uniformly insist that their children shall be better educated, in better school buildings, than their own generation enjoyed. More automobiles require improved highways and more off-street parking facilities. Because our people are more concerned with public health than their forebears, they require more elaborate and efficient sewage disposal facilities. More labor-saving devices mean heavier loads for electric plants.

And so it goes. Making the world a better and safer place in which to live and work is costly. Few major public works can be acquired without incurring major costs. Commonly, these costs are met by bond issues. Borrowed money (bond issues) almost always means higher taxes in the long run because the borrower is required by the hard

facts of life to pay interest. But bonding offers the advantage of the equivalent of an installment plan method of purchasing the improvement. In other words, the cost of a project may be spread out over several tax years.

Cities and other public bodies with capital outlay programs in mind should lay their financial plans long in advance of the time they need the cash in hand to pay construction costs. Only by establishing their credit and striving to improve it can they assure their taxpayers and utility rate payers that improvements are being financed as economically as possible.

The price a city can fetch for its bonds (the upside-down way of saying how low an interest rate it will have to pay on the bonds) depends upon a combination of many things. Some are beyond the city's control and influence. For example, the availability of funds (the amount of money in the hands of commercial banks, savings institutions, insurance companies, pension funds, individuals and other classes of investors) depends in part upon the flow of free funds into the hands of investors, and in part on the competition for these funds (i.e., the extent of the demand of prospective home owners for mortgage money; the need for business enterprises to raise capital for inven-

**D. M. ELLINWOOD**

Vice President

Moody's Investors Service

tories, for consumer credit or for plant expansion; and the extent that other cities and school districts wish to borrow money for one reason or another).

The law of supply and demand has no statutory basis, but it is no less effective. There is nothing a city can do to alter this natural law which governs bond prices and interest rates in an over-all way. But there is a great deal a city can do about it by way of improving the value of its bonds in relation to the value of other bonds.

A city alone governs the supply of bonds bearing its name. Also, it can do much to influence the demand factor by whetting investors' appetites for its bonds over other securities. The value of a city's bonds is determined by the size of its market, by which is meant the quantity of its bonds investors are willing to buy at a given price. In turn, this is determined by how widely and how favorably the city is known; in other words, by the length and breadth of its credit.

#### **How Ratings are Used**

Credit is the principal, almost the sole, ingredient of bond ratings. It is commonly known that ratings are widely used by banks, insurance companies and other investors as a guide in bond selection. Beyond this, the ratings are particularly meaningful when applied as a measure of portfolio security on an over-all basis. Of themselves, ratings are not a forecast of market values or of price performance. In essence they represent independent opinion regarding the ability of the borrower to conform to the terms of the contract which he has negotiated with those from whom he has borrowed money. In other words, the ratings are concerned with the security or safety of an individual bond.

Ratings are not a reflection of bond maturity or marketability except in rare cases where the combination of maturity and marketability itself has a direct bearing on the prospects of payment. Security, or safety (relative certainty of the payment of interest and principal), remains as the principal, almost the sole, ingredient of the ratings.

\*It must be clearly understood that everything said here about ratings refers to Moody's ratings, for the writer has no firsthand knowledge about other rating systems.

Moody's bond ratings are designed solely to provide a broad indicator of independent opinion regarding the investment quality or safety of bonds. These are in purposely broadly defined gradations. The letter symbols in our system are "Aaa", "Aa", "A", "Baa", "Ba", "B", "Caa", "Ca" and "C". The effect would be much the same if one were to substitute adjectives such as excellent, good, fair, poor, speculative, and so on down.

There are only nine classes in Moody's rating system. In rating several thousand bond issues with so few symbols, it follows that ratings cannot reflect the fine shadings of risk which actually occur. Bonds carrying the same ratings are not claimed to be of absolutely equal quality, but are claimed to be essentially alike in their expected investment performance.

#### **Basic Principles**

Moody's ratings are not the product of any statistical formula wherein balance sheet calculations, revenue and expense comparisons, etc., alone are taken into account. Naturally, such materials are used extensively, but great weight is given also to numerous economic and other non-financial factors. The ratings represent the considered judgment of a group of experienced analysts about the probable future performance of bonds over the long term. As used here, long term means: As far ahead as the practical imagination will permit, and in any case long enough to span a business recession of some severity.

A conscientious effort is made to keep the ratings from being mere expressions of fair weather risks or even of average weather risks. Although historical data are used as a matter of course, it is in the future that presently outstanding bonds will become due and payable. Thus, in the appraisal of long-term risks, economic, social and political trends and tendencies are considered, among other things.

In the case of utility revenue bonds, the possibility, if any, that additional capital funds may be required at some later date (while the bonds under study are still outstanding) is appraised; the possible consequences of additional financing to the present bondholders are weighed. In the case of general credit bonds, particular considera-

tion is given to the possible capital needs and revenue requirements of all governmental units imposing both direct and indirect taxes on the business life of the community whose affairs are under study. Ratings are reviewed periodically. Constituted as they are, ratings do not change with each review. In other words, they do not change in reflection of annual or sometimes even of decennial changes in the current financial standing of a community. Ratings are revised only as Moody's is convinced that long-term risks are increasing or waning.

As was noted previously, several thousand bond issues are rated. But many more thousands are not. Moody's does not attempt to rate bonds payable solely from special benefit assessments, nor bonds payable solely from the earnings of a hospital, university or other public or so-called "non-profit" institutions. Also excluded from the rating system are bonds in which there is a minimum of public interest (privately held as a whole, or outstanding in an amount less than \$600,000).

Finally, bonds excluded from the rating system include issues where current information is not available in sufficient detail to permit conclusive analysis. These comprise two types of situations. First, there are the obligations of municipalities which have failed to respond to requests for current information in reasonable detail. Secondly, there are bonds which are payable solely from the earnings of a project which has no record of earnings. The case of a toll bridge revenue bond is typical; there will be no earnings at all until such time as construction is completed and the facility is open to traffic and tolls.

#### **Basic Elements of Bond Quality**

Beyond the foregoing outline of what ratings are, what they are not, and how they are used, readers of PUBLIC WORKS may be interested in a brief discussion of the points of weakness and strength for which bond analysts watch, the points which qualify some bonds as best-secured and the considerations present in some instances which indicate definite shortcomings (from the investor's point of view).

Between general credit bonds and revenue bonds points of emphasis vary somewhat. Even so, in a broad

(Continued on page 195)



● ARCHITECT'S sketch shows how the New Jersey Motor Vehicle Inspection Stations will appear. The long portion at left is a three-lane inspection station; T-shaped building houses business, driver examination and driver clinic facilities. Included on site but not shown in sketch is a driver test course.



## Facilities For MOTOR VEHICLE *Inspection*

**T**O MEET THE needs for inspection and other field activities of the New Jersey Division of Motor Vehicles, a one-story facility was designed, easily expandible from one to four components. The variable in design include future population trends and shifts, anticipated specific needs of the various areas, site acquisition costs and the uniting of many activities presently scattered throughout the state.

To meet these variables, design breaks down into four phases or components:

Phase I comprises the basic unit common to all 49 planned installations. It consists of: (1) Structure housing three inspection lanes, each equipped with devices for detecting defects. In certain installations the third lane will be deactivated until conditions warrant its use; (2) Service core housing all mechanical facilities pertinent to the installation and rest, toilet and administrative facilities for staff. The inspection structure and service core comprise 13,490 square feet. (3) Four off-street stacking lanes accommodating a minimum of 30 waiting vehicles each. Three of the lanes will each lead to an inspection lane. The fourth will lead to a re-inspection aisle; this will be (4) an open aisle, 24 feet wide, adjacent to the inspec-

Based on data furnished by  
**Frank Grad & Sons, Architects  
and Engineers, Newark, New Jersey**

tion structure, for re-inspection of vehicles rejected for minor faults. (When re-inspection involves steering mechanism, wheel alignment, headlights or brakes, rejected vehicles must return to the primary inspection lane); (5) an off-street parking area for employees.

Phase II comprises a 4,305-sq.ft. business office housing: Quarters for issuing driver licenses, learner permits, vehicle registrations, certificates of ownership and other items; lobby and waiting space; first-aid room; public and staff toilet facilities; space for motor vehicle patrol, with radio communications; storage space; and provision for air-conditioning.

Phase III comprises an examination center and drivers' skill test course, consisting of (1) a 2,665-sq. ft. structure housing: administrative offices; examination room; spaces for psycho-physical tests; employee rest and toilet facilities; and provision for air-conditioning.

(2) A four-acre test course simulating actual road conditions with: brake test on grade; stop street, serpentine steering course; 90-de-

gree parking and 180-degree turn-around.

(3) An inspectors' station, serving as pick-up point for examinees' cars, houses waiting space, field inspectors' control point and public toilet facilities.

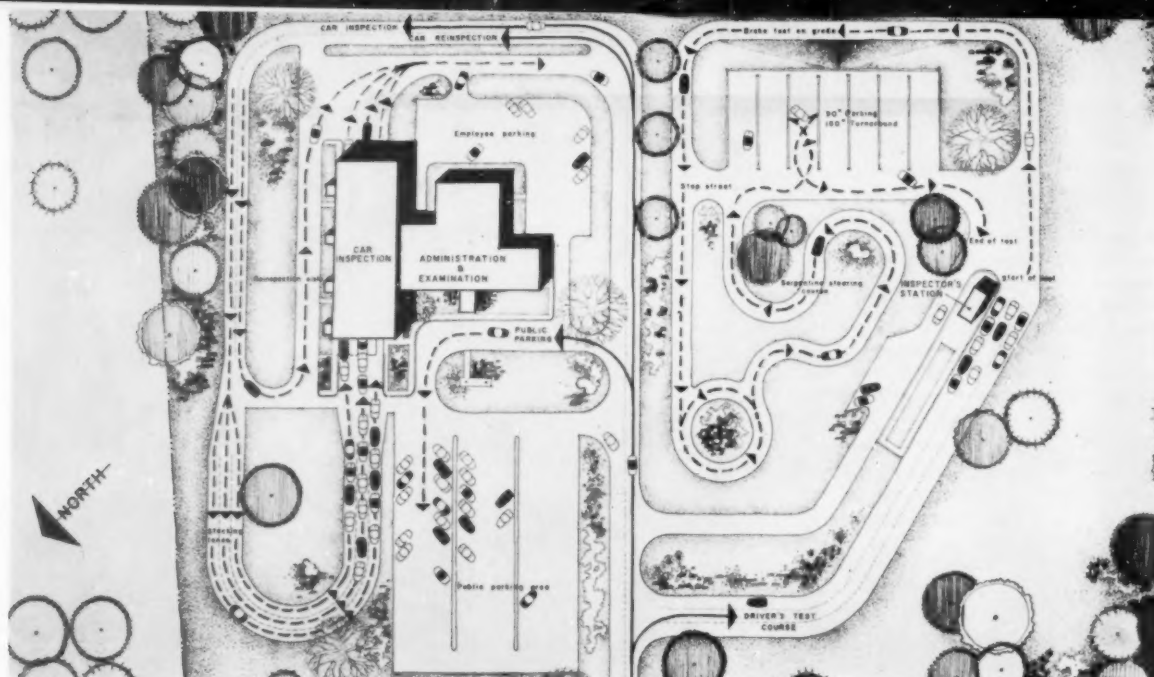
Installations combining the first two phases will have an off-street public parking area for 50 cars. This area is upped to 100 cars for three-phase installations. The parking sites will be for the accommodation of persons visiting the center or for examination administration.

Phase IV comprises a 1,625-sq. ft. drivers' clinic for testing persons deemed accident or violation prone. Tests to be given here are classified as: Psycho-physical, psychological, educational and corrective and law and regulatory.

The design features expansion in horizontal direction, utilizing one-story design. The original design was predicated on concrete slab on grade and steel column and frame construction. However, the next seven installations will employ prestressed pre-cast concrete frame because of the inability of steel fabricators to meet delivery schedules.

Construction also includes modular window-wall panels, movable steel office partitions, aluminum window wall and sash, asphalt tile, vinyl and flagstone flooring; acoustical tile ceiling in office and examination areas, and provision for air-conditioning. Inspection lanes will employ monolithic concrete slab with surface hardening.

Inspection structures will be ventilated by an underground exhaust system employing four exhaust trenches surmounted by floor grills. Each trench will lead to an exhaust



● SKETCH depicts flow and facilities in four-phase field installation designed for the New Jersey Division of Motor Vehicles.

fan mounted in a housing on the exterior of the building. With a working capacity of 90,000 cubic feet per minute, the system will produce approximately one complete air

change per minute, in line with criteria developed by the State Board of Health.

Road surfaces will be blacktop. The main arterial road has branches

servicing the three basic areas: stacking lanes for vehicle inspection, driver test course and public parking for the administrative and examination areas.

## Nomograph Solves Box Culvert Design

GEORGE P. FULTON

Brown & Blauvelt,  
Consulting Engineers  
New York, New York

SEVERAL TRIAL hydraulic calculations are necessary to determine the box culvert size that best meets any set of given design conditions. Nomographs now available, such as those of the Bureau of Public Roads, are limited, one to each width dimension so that 18 sets of curves are necessary for complete coverage between the widths of 3 feet to 20 feet. The nomograph presented here for the Manning formula enables the designer to accomplish a box culvert or vertical side channel design in a fraction of time required by long-hand methods or by means of other available charts. The fact that all the design is done on a single chart has

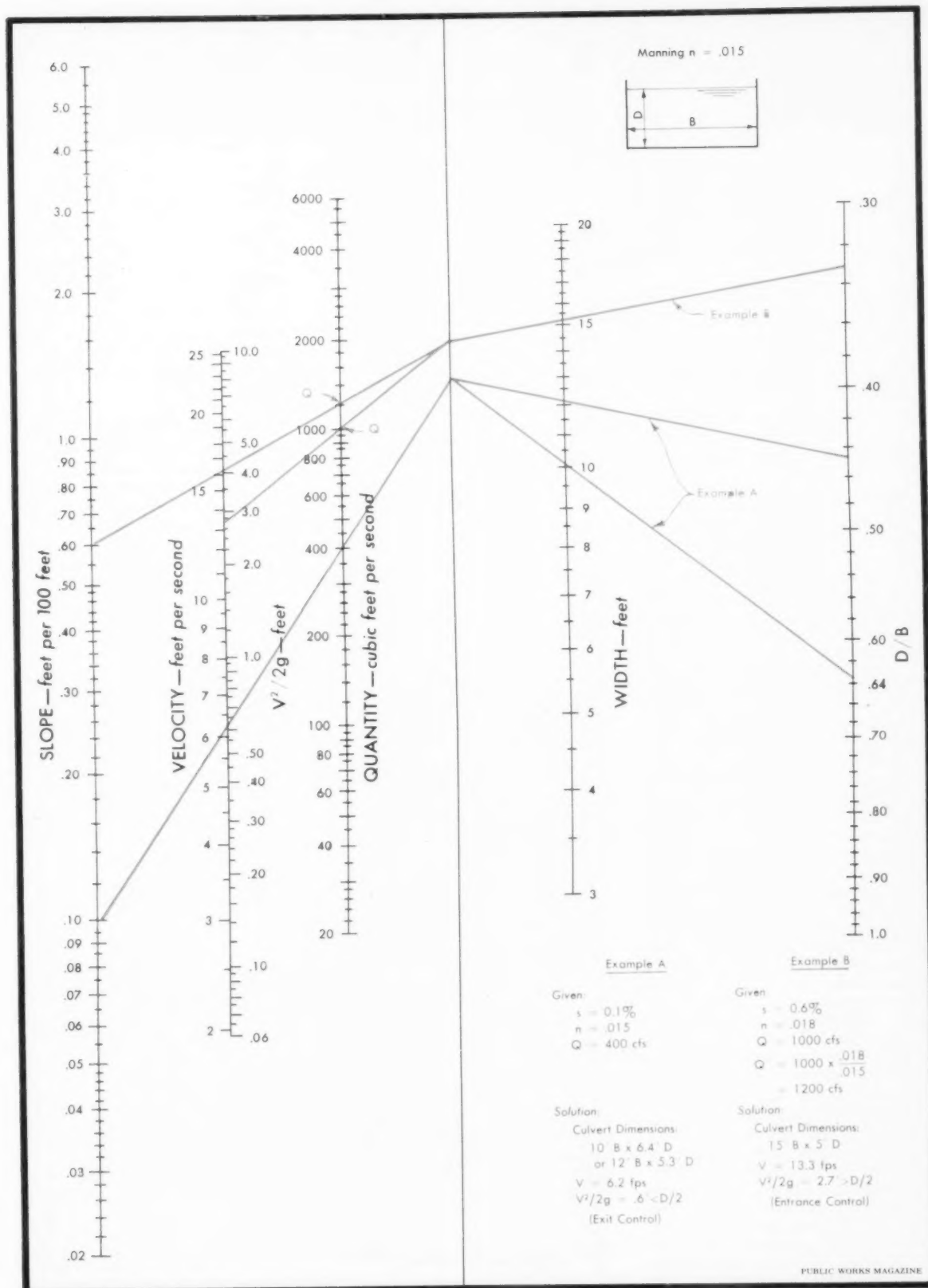
the added advantage of indicating the several solutions of a design at a glance.

A straight line through any two values of slope, velocity or flow quantity establishes the third value on the left side of the pivot line. A line drawn from the intersection of this line and the pivot, determines a width and flow depth of the various culverts meeting the design conditions previously established. Velocity is almost exactly a factor of slope and flow quantity alone when D/B is limited to the range of 0.3 to 1.0. Resultant velocities of flow for all the culverts in this range carrying a given quantity at a given slope will vary a maximum of 2 percent from the mean value.

The velocity head ( $V^2/2g$ ) scale is provided to permit determining entrance conditions. When  $V^2/2g$  is more than 0.5D, entrance control

exists and when velocity head is less than 0.5D, exit control exists. The appropriate constant for the type of culvert entrance multiplied by the velocity head gives the entrance surcharge for the exit control condition. Backwater and dropdown calculations for box culverts or vertical walled channels can be shortened by using the nomograph for many of the trial steps necessary.

The chart values are established for a Manning  $n = .015$ . For other friction values the flow quantity must be adjusted in proportion to  $n/.015$  before using the nomograph to solve for slope, quantity, width and depth. Velocity is obtained by the intersection with the line drawn through the point on the pivot and the original flow quantity. The nomograph is suitable only for the open channel condition with the top surface free.



● SINGLE nomograph chart solves design of box culverts or vertical side channels between widths of 3 feet to 20 feet.  
 PUBLIC WORKS for October, 1956



# WINTER

**JAMES D. HARTSHORNE**

Director of Information and Research, Ohio Turnpike Commission

**S**OON AFTER THE opening last October of the remaining 219 miles of the Ohio Turnpike west of the already opened 22-mile "East-gate Section" in the Youngstown area, the long northern Ohio winter moved in, and before it was through, had assaulted the turnpike with 66 major storms.

Russell S. Deetz, Project Manager of the Turnpike, recently said that he was convinced that the engineers who plotted the course of the \$326,000,000 toll road chose the "snowiest, blowiest, iciest" location in Ohio. Deetz wondered if they might not have used a weather map instead of a topographical map in locating the turnpike.

It was not a record-breaking winter, but the kind that Ohio Turnpike maintenance forces will expect. The easternmost 80 miles of the turnpike, between the southwestern suburbs of Cleveland and the Ohio-Pennsylvania state line were especially subject to snowfall. During winter months in this section, the wind shifts to the northwest and blows off Lake Erie about once every three days and this brings snowfall to the eastern turnpike area which generally persists for about 30 hours.

Snow and ice removal is important on a public highway. It is an even more vital operation on a toll road, where time-saving and safety constitute the principal stocks-in-trade. Delays resulting from icy road surfaces tend to cancel out some of the advantages of traveling a toll road. The user pays his way and accepts no excuses for delay.

Because of the nature of turnpikes, several problems of ice and snow removal have been made more acute. Since the Ohio Turnpike's two directional roadways are separated by a 56-foot depressed median strip, it is necessary to maintain not 241 miles of 4-lane highway but, in fact, 482 miles of 2-lane highway. Maintenance operations were originally commenced without the use of crossovers in the median strip, but the necessity for such crossovers became apparent early in the operation of the East-gate Section, and turnpike maintenance forces proceeded to construct crossings at intervals of about five miles. Crossovers were also constructed just east and just west of each of the 15 interchanges. These crossovers minimize "dead-haul" mileage of maintenance trucks. The

depressed median strip offers a great advantage, too, in ice and snow removal. Snow cleared from the roadway into this sunken area will, as it melts, flow into the drains.

The sustained high speed of turnpike vehicles makes the operation of maintenance equipment especially hazardous. No longer do workers stand on the back of trucks to dump and spread abrasives; hopper-type spreaders are used. On the rear of each maintenance truck are four flashing red lights, two on each side, wired for a criss-cross flashing pattern.

## System for Snow and Ice

Basically the Ohio Turnpike system of snow and ice control during the winter of 1955-56 depended on the use of abrasives, with light chemical treatment in deference to the new concrete. The operational procedure might be described as a "zone defense" type with each piece of equipment assigned to a specific section of pavement under average storm conditions.

The maintenance program is administered in the Ohio Turnpike Commission's Berea headquarters, located on the north side of the turnpike in the southwestern reaches of metropolitan Cleveland. The maintenance department is headed by a maintenance engineer, who is directly responsible to the Project Manager. The maintenance engineer's staff at Berea includes an assistant, a superintendent of sewage and water-treatment plants, an equipment superintendent, and clerical personnel.



● FIRST WINTER'S operation of the Ohio Turnpike has shown importance of trained personnel and good equipment. Here a motor grader removes snow from roadway.



# on the Ohio Turnpike

In the field the maintenance organization is divided into eastern and western divisions, both covering about the same turnpike mileage. In each of these two areas there is a division maintenance superintendent, assisted by a master mechanic, an electrician, a plumber, a clerk and an assistant clerk. Each division encompasses four maintenance sections, each approximately 30 miles in length. Each section crew consists of a foreman, a clerk, a mechanic and some 14 equipment operators and laborers.

The operating quarters for each of the eight turnpike sections is a modern maintenance building, constructed of steel and concrete block faced with brick, approximately 150 x 85 ft., with office, lockers and washroom, storeroom, mechanic's

bay, radio room and equipment storage bay. Three of the eight buildings have an office and dormitory for District 10 (the Ohio Turnpike contingent) of the Ohio State Highway Patrol. Two of the buildings are division headquarters; one has a sign shop.

In addition to the building itself, a large storage yard and drives with access to the local road system are included in the area. Gasoline pumps with underground storage tanks are installed along the side drive to the building. Direct access to the turnpike is provided.

An essential ingredient to the turnpike's maintenance system, especially during snow and ice storms, is the radio-communications system which brings all turnpike personnel into close contact

with one another, and expedites the directing and coordinating of activities from Berea. The radio system utilizes several channels, most important of which is a common communications circuit permitting two-way conversations between persons in the headquarters building, the eight maintenance buildings, toll booths, maintenance trucks and other vehicles provided with mobile equipment. A console for monitoring the entire radio system is located in the Berea headquarters, where it is connected with another channel of the turnpike radio system used by the Highway Patrol. Still another channel is used for a radio-telephone system with selective dialing between the Berea building and the maintenance buildings, and a fourth channel provides radio teletypewriter service for transmitting written messages between the administration and maintenance buildings. A fifth channel is reserved for use by radio maintenance personnel. The radio circuits are carried over the entire length of the turnpike by microwave, with a directional antenna located at each of the maintenance buildings and at Berea.

## Storm Operations

During storm operations the radio system permits rapid exchange of weather and road information, speedy transmission of instructions and frequent conferences between maintenance personnel in Berea and in the field on methods of procedure and types of abrasives needed. Toll collectors also keep the maintenance foremen advised by radio as to weather and roadway conditions, and in turn receive information which enables them to warn travelers by means of printed slips, signs and word of mouth.

To keep all equipment operating throughout storms of whatever duration, it was necessary to use many of the employees overtime and to hire temporary employees, many of whom were farmers living near the turnpike. Maintenance mechanics, greasemen and clerks are also used when needed to operate equipment. Consideration is being given to using two permanent shifts next year.

The basic rolling equipment for snow and ice removal at each of



● INTERCHANGE ramps become critical sections during storms. Steeper grades and shorter radii make them hard to clear; stalled cars easily block the one-lane road.

the eight sections includes one or two large 8-yard trucks, each with front and wing plows, underbody blade and hopper body with spinner disk fed by belt conveyors; six 5½-yard trucks equipped with snow plows and interchangeable dump and hopper bodies, the latter having bottom belt conveyors to spinner spreaders; one motor grader equipped with a V-plow; and one or two front-end loaders for loading abrasives in the yard.

Experience during the past winter has indicated the need of additional large trucks for use on the main line so that smaller trucks can be assigned, one to each interchange. The shorter radii and steeper grades of interchanges make the ramps critical sections throughout a storm, and stalled vehicles of patrons can quickly block these one-lane roads. It has also been found desirable to have two front-end loaders in all maintenance sections, one to handle intermediate stockpiles and one for use at the maintenance yard. After the past winter's experience, the Commission expects to schedule and control the use of each piece of rolling equipment so that the function of each will be clearly defined in any storm. Prior to the onset of next winter, each piece of equipment will be thoroughly tested and put in shape for use in the first snowstorm.

### **Snow and Ice Control**

The three materials used for the control of ice and snow on the Ohio Turnpike are abrasives, calcium chloride and sodium chloride. Abrasives, in addition to producing a driving surface with sufficient traction for safe operation of vehicles, serve during snowstorms and at night to define traffic lanes. Experience shows that abrasives should be dark in color to provide a contrast to the snow and ice, and should be of sufficient weight, coarseness of gradation and surface angularity to assure good traction and distribution on the roadway without scattering in too broad or too thin a pattern.

Calcium chloride is used to keep stockpiles of abrasives unfrozen and ready for use. It serves also as a melting agent greatly improving the abrasive particle's imbedment in the frozen traffic lane surface when spread in a storm. Under proper temperature and storm conditions an increase of proportions of calcium chloride to abrasives results in the partial melting or "slushing" of frozen surfaces. The

slush is then readily removed with blades.

Sodium chloride functions most effectively at lower temperatures in combination with calcium chloride. Desirable percentages of calcium and sodium vary according to storm and roadway conditions. Based on the Commission's experience, it is expected that snow and ice removal activities during the coming year will require 33,000 tons of abrasives, 3,850 tons of calcium chloride, and 6,600 tons of sodium chloride.

It is planned for next winter to place supplemental stockpiles of abrasives at strategic locations along the turnpike to reduce dead-heading of empty trucks. The number of stockpiles will be determined on the basis of relative cost of operating such stockpiles as opposed to deadheading costs and overall efficiency. For reasons of economy abrasives will be obtained from sources located as close to the turnpike as possible.

### **CaCl<sub>2</sub> + NaCl**

Last winter the Commission experimented in the use of a chemical which combines calcium chloride and sodium chloride in the same pellet in proportions of 25 percent and 75 percent, respectively. On one occasion, with snow falling continuously for about 15 hours, one heavy application of this chemical, followed by plowing and treatment with a chemical-abrasive mixture, kept the turnpike entirely free of ice or packed snow throughout the period. The slush was easily plowed and the pavement was clear and dry within one hour after the end of the storm.

The sequence of events in a typical northern Ohio snowstorm follows a pattern which is often repeated but is not always foreseeable.

Warning of the storm may be received over the administration building's direct teletype line from the U. S. Weather Bureau at Cleveland Hopkins Airport a few miles away. For individual sections, foremen utilize local sources of weather information. Upon evidence of an approaching storm, members of the maintenance staff patrol the turnpike to watch for developments. If the nature of the storm appears to be unpredictable, small trucks loaded with abrasives may also patrol the turnpike in order to give temporary but prompt treatment to critical locations.

Prompt inauguration of snow control operations is of vital importance. Delay may result in al-

most insuperable difficulties. Snowplowing on the roadway and bridges is begun as soon as the fall is of sufficient depth for the equipment to operate effectively. Treatment with abrasives follows.

In sleetstorms prompt use is made of chemically treated abrasives. If ice is forming and temperatures dropping rapidly, it is sometimes necessary to use a limited amount of straight chlorides at critical points. For rains with temperatures approaching freezing, trucks loaded with abrasives proceed to locations where experience indicates that ice is most likely to form first. When there is snow and ice on the roadways, with temperatures just above freezing, the melting snow and slush is plowed off as quickly as possible in order to prevent ice formation in the event of a later temperature drop.

When roads become hazardous, patrons are warned upon entering the turnpike, and speed limits are reduced to such levels as will insure safe passage.

The turnpike's sixteen service plazas, where patrons obtain food and fuel, also offer critical areas, beginning with the acceleration and deceleration lanes where changes of speed make good traction imperative. Snowfall requires immediate attention to the plowing of truck and passenger car drives within plaza areas. Due to the nature of the area, snowfall quickly obscures the drives and patrons become mired in the berms or strike curbs unless the drives are defined by plow lanes and abrasives distribution patterns.



Parking areas are less critical but become a source of considerable inconvenience to patrons unless cleared at an early hour after a snowfall.

In the event a storm is sufficiently severe to disrupt normal procedures, the following priority is established for control operation: 1) roadway (outer lane first); 2) interchanges; 3) service plazas (acceleration and deceleration lanes first); 4) shoulders (each directional roadway of the Ohio Turnpike has 8-foot in-

*(Continued on page 169)*

# Water and Sewage

## CHEMISTRY and CHEMICALS

*Revised and Expanded by*  
**KENNETH W. COSENS,**  
Associate Professor of  
Sanitary Engineering,  
The Ohio State University

Information, in simple and understandable terms, to help  
the water or sewage plant operator in his daily work

SINCE THIS text is intended primarily for refresher and reference purposes, and for beginners, it is desirable before starting a discussion of the principles of chemistry and chemicals, to be sure that certain fundamentals are stated so that the meaning of terms, phrases, units and symbols will be clear.

Atoms, elements, molecules and compounds must be understood for these things are most important in chemistry.

An atom is the smallest part of an element which will react in a simple chemical change. Elements, in chemistry, are those substances which cannot be divided into simpler substances by ordinary types of chemical changes. Each element is made up of, and consists wholly of, atoms of only one kind. A molecule is the smallest unit quantity of an element which can exist by itself and retain all the properties of the original substance. For instance, one atom of calcium forms a molecule of the element calcium and the atomic and molecular weight is the same. It takes two atoms of chlorine to make a molecule of chlorine and eight atoms of sulfur combine to form the smallest molecule of sulfur. The atomic weight of sulfur is therefore one-eighth its molecular weight. About 100 elements have been discovered. Approximately 25 of these are of importance in water, sewage and similar work. A good many others are used in connection with various tests and analyses. A list of the chemical elements frequently used in water and sewage treatment is shown in Table I. This table also shows the symbols or abbreviations used to indicate an atom of an element. The atomic weight and valence of the element is also given.



Some Basic Tools of the Sanitary Chemist

Aids for the water and sewage analyst are functional in character, designed to render efficient service under exacting conditions. Test procedures specify equipment to be used. Items shown include an Imhoff cone for determination of settleable solids in sewage; volumetric flasks and graduated cylinders for liquid measurements; a beaker for mixing liquids, solutions of solids, and a variety of other uses; an Erlenmeyer flask for titrations; a porcelain dish for evaporations and some titrations; a suction flask with a Gooch crucible; BOD bottles; and other items.

Table I—Properties of Elements

Elements	Symbol	Atomic Weight	Valence*	
			+	-
Aluminum**	Al	26.97	3	
Barium	Ba	137.36	2	
Bromine	Br	79.92		1
Calcium**	Ca	40.08	2	
Carbon**	C	12.01	2,4	4
Chlorine**	Cl	35.46		1
Chromium	Cr	52.01	3,6	
Copper	Cu	63.57	1,2	
Fluorine	F	19.00		1
Hydrogen**	H	1.01	1	
Iodine	I	126.92		1
Iron**	Fe	55.85	2,3	
Lead	Pb	207.21	2,4	
Magnesium**	Mg	24.32	2	
Manganese**	Mn	54.93	2,4,7	
Molybdenum	Mo	95.95	6	
Nitrogen**	N	14.01	3,5	3
Oxygen**	O	16.00		2
Phosphorus	P	30.98	5	
Platinum	Pt	195.23	4	
Potassium	K	39.10	1	
Silicon	Si	28.06	4	
Silver	Ag	107.88	1	
Sodium**	Na	23.00	1	
Sulfur**	S	32.06	4,6	2
Uranium	U	238.07	3,4,6	

\*Those valences in common use in water and sewage chemistry.

\*\*Most commonly used in water and sewage chemistry.

More on this later. The twelve most common elements for the operator are double starred. These twelve symbols should be memorized.

### How Chemicals Were Named

Most elements have a common or popular name, but in chemical work they are represented by symbols consisting of the first or the first and another letter of their Latin or Greek names. For instance, Ca is the symbol for calcium; Fe is the symbol for iron, for which the Latin term is ferrum. Ag is used for silver, again based upon the Latin term argentum, and Au is similarly used for gold. Pb is for lead or plumbum; N for nitrogen; H for hydrogen; O for oxygen; C for carbon; Cl for chlorine; Cu for copper or cuprum; and Na for sodium.

These symbols are joined together to designate certain chemical compounds which are formed by the combination of atoms of various elements. For example, common table salt is composed of sodium (Na) and chlorine (Cl) and the symbol or formula for the compound, sodium chloride, is NaCl. This indicates that one atom of sodium and one atom of chlorine have combined to form one molecule of the compound common salt.

Pure water is a combination of two parts hydrogen and one part oxygen.  $H_2O$ . The small or subscript "2" indicates that two atoms of hydrogen are combined with one atom of oxygen. Since no subscript appears in the formula for NaCl, it indicates that equal numbers of sodium and chlorine atoms are combined. All matter or compounds, everything we recognize, is composed of combinations of the various elements according to chemical laws. Most matter is made up of simple compounds, composed of only two or three elements. Others are very complex. Salt and water are examples of simple common compounds. On the other hand, the well known insect killer, DDT, or dichloro-diphenyl-trichloro ethane is a complicated organic compound of the elements chlorine, carbon and hydrogen.

### How We Weigh Chemicals

Every known chemical element has an atomic weight. This weight is relative only and except for certain gases, cannot be translated into pounds or ounces to indicate how much any specific volume of a chemical actually weighs. The atomic weight of elements is based on an assumed atomic weight for

oxygen of 16.00, and represents the true relative weights of the other elements. The atomic weight is very important, because two or more elements always combine in proportion to the atomic weights of the various elements composing the compound. Thus sodium and chlorine always combine to form sodium chloride in the proportions of 23.00 parts of sodium to 35.46 parts of chlorine, by weight. Valence is also involved. It will be explained later.

Some chemicals are solids, some are liquids, others are gases. In any case, each has a specific gravity or density. Density is used to measure the weight of substances and may be defined as the weight (mass is more technical) per unit of volume. Lbs. per cubic foot or grams per cubic centimeter are units of density. Specific gravity is the ratio of the mass or weight of a substance and pure water under specified standard conditions. Pure water under a specified condition of temperature and pressure has a specific gravity of 1.00. A liquid that has a specific gravity of 1.85 is 1.85 times as heavy as an equal volume of water. The specific gravity of gases is determined by comparison with the weight of pure, dry air under standard conditions of pressure and temperature. A gas having a specific gravity of 1.54 weighs 1.54 times as much as an equal volume of air at the same pressure and temperature. The density of dry air at 0°C. and 760 mm pressure is 1.2929 grams/liter.

### Valence and Chemical Radicals

Different elements have widely varying capacity for combining with other elements. The combining capacity of an element is called valence. The valence of an element is a number which represents the number of positive (+) or negative (-) charges carried by a substance, or it is the number of atoms of hydrogen, or its equivalent, which one atom of the substance displaces or with which it combines. Valence is a relative power with the valence of the H ion being taken as 1. From this the valence of other elements is determined. Valence may be either + or - and when atoms combine to form compounds the + and - valences must be balanced. For instance  $H^+$  and  $Cl^-$  combine to form HCl; or  $H^+$  and  $SO_4^{--}$  combine, with two  $H^+$  and one  $SO_4^{--}$  to produce  $H_2SO_4$  which is balanced as far as + and - valences are concerned. Table I gives the + or -





Courtesy Burgess & Niple, Consulting Engineers.

● **WATER TREATMENT** plant laboratory located at the Washington Court House plant of the Ohio Water Service Company.

valences of the common elements. Note that some elements display the property of having more than one valence. For instance CO, carbon monoxide, indicates that C has a valence of +2, but CO<sub>2</sub>, carbon dioxide, indicates that C has a valence of +4 because it combines with 2 atoms of O, each having a valence of -2.

In water and sewage chemistry we encounter certain common grouping of atoms which react chemically as would a single atom. These groups are called radicals. They even have a characteristic positive or negative valence the same as the elements do.

Positive charged atoms are called cations, negative charged atoms or radicals are anions.

The positive valence indicates a surplus of protons on the element or radical. A negative valence has a surplus of negative charges of electricity called electrons. We see then that when elements combine chemically to form compounds they combine electrically as well. The number of protons must equal, and therefore neutralize, the electrons. This is the reason why hydroxides and nitrates do not combine. They both have - valence. A + valence element or radical always combines with a - valence element or radical to produce electrical neutrality.

**Acids, Bases and Salts**—These three terms are used frequently, and their meaning must be understood. An acid is a compound that contains hydrogen, which may be replaced by a metal. Thus HCl, hydrochloric acid, may be changed to NaCl, common salt, by replacing the H with Na. In the same fashion H<sub>2</sub>SO<sub>4</sub>, sulfuric acid, is changed to CaSO<sub>4</sub>, calcium sulfate or gypsum, by replacing the H<sub>2</sub> with Ca, a metal.

A base is the oxide or hydroxide of a metal. For instance, common bases are CaO, calcium oxide or quicklime; NaOH, caustic soda or sodium hydroxide; and Fe(OH)<sub>3</sub>, ferric hydroxide. Reactions of acids and bases produce salts such as NaCl, CaSO<sub>4</sub> and CaCO<sub>3</sub>. The latter compound, which is calcium carbonate, is formed when CaO, quicklime, reacts with carbonic acid, H<sub>2</sub>CO<sub>3</sub>.

In the previous discussion, the term "metal" is not restrictive, as it includes potassium, sodium, calcium and magnesium, as well as copper, lead, iron and gold.

### Units for Measuring Chemicals

Before proceeding further, it is desirable to consider units of measurement. Chemical analyses must be exact in order to provide bases for chemical reactions, and must be stated in terms that mean the same to everyone. Several methods are in use to indicate the strength of solutions or the amount of a material present in water or sewage. The most common methods: Parts per million, abbreviated ppm; grains per gallon, abbreviated gpg; pounds per million gallons, lb/MG; and in the metric system, milligrams per liter, mg/l, which is equivalent to parts per million. A

milligram is 0.001 gram. The abbreviation MG is used for million gallons and mg for milligrams. Care will avoid confusion in its use.

**Our Every-Day Measurements**—The U. S.-English System is based on pounds, grains and gallons. In using this system grains should not be confused with the grams of the metric system as 1 gram equals 15.43 grains. There are 437.5 grains in an ounce, and 16 ounces in the ordinary avoirdupois pound. Therefore there are  $437.5 \times 16 = 7000$  grains per pound. One U. S. gallon of water weighs 8.34 lbs. Then 1 ppm = weight of 1-gallon in 1,000,000 gallons. Therefore 1 ppm = 8.34 lb/MG.

Also note that 1 gpg = 1,000,000 grains/MG. =  $(1,000,000 \div 7000)$  lbs/MG; therefore 1 gpg = 142.9 lbs/MG. From this we compute the important relationship that 1 gpg =  $(142.9 \div 8.34) = 17.1$  ppm.

Example: Flow rate is 15 MGD, and 28.5 ppm of a given chemical is to be applied. Determine (a) the grains per gallon rate of feed and (b) the lbs. of the chemical added per day. Solution (a)  $28.5 \div 17.1 = 1.67$  gpg and (b)  $28.5 \times 8.34 \times 15 = 3570$  lbs.

Canadian or Imperial gallons are larger than U. S. gallons. The U. S. gallon is 0.83 the Canadian or Imperial gallon. The proportions above must be modified accordingly.

**Table II—Common Chemical Radicals**

Radical Symbol	Radical Name	Valence		Atomic Weight of the Radical
		+	-	
NH <sub>4</sub>	ammonium	1		18.05
HCO <sub>3</sub>	bicarbonate		1	61.02
CO <sub>3</sub>	carbonate		2	60.01
OH	hydroxide		1	17.01
NO <sub>3</sub>	nitrate		1	62.01
NO <sub>2</sub>	nitrite		1	46.01
SO <sub>4</sub>	sulfate		2	96.06

**The Metric System**—The metric system is based upon the decimal system and actually is much simpler to use than the English system of weights and measures. In the metric system, the standard unit of volume is the liter, which is slightly more than one quart. A liter contains 1,000 cubic centimeters (usually abbreviated cc). The term milliliter, which means one one-thousandths of a liter (and is abbreviated ml) is now more generally used than cubic centimeter. For all practical purposes the terms are interchangeable. The standard unit of weight is the gram, which is the weight of one cc (ml) of water at a standard temperature. The kilogram (kg) is 1000 grams (about 2.2 pounds). The milligram is one one thousandth of a gram. It is convenient to remember that 1 mg per liter equals one part per million.

**Temperature**—Both the Fahrenheit and the Centigrade scales are used to measure temperature. Under standard conditions the freezing point of pure water is 32°F and 0°C while the boiling point is 212°F and 100°C. Note that on the Fahrenheit scale there are 180° between freezing and boiling while on the Centigrade scale there are 100°. The degree Centigrade is therefore larger than the degree Fahrenheit by the ratio of 9/5. Example: Change 20°C to Fahrenheit. Solution: 20°C above freezing is  $20 \times \frac{9}{5} = 36^\circ\text{F}$  above

freezing. Therefore the Fahrenheit temperature is  $36^\circ + 32^\circ = 68^\circ\text{F}$  and  $20^\circ\text{C} = 68^\circ\text{F}$ .

**The Baumé scale** is used in the chemical industry to measure specific gravity. The degrees Baumé measures the concentration of the chemical and is therefore a basis of price of chemicals. With most water solutions of chemicals the specific gravity varies directly with the amount of the acid, alkali or salt present in solution.

Densities and specific gravities are numerically the same when density is expressed in gm per ml. for most practical purposes. Since the specific gravity of a liquid varies with temperature, it is necessary to state the temperature. Chemical manufacturers in the United States have agreed on and use 60°F as a basis for specific gravity. Therefore degrees Baumé compares the weight of a volume of liquid at 60°F with the same volume of pure water at 60°F.

While specific gravity, to be accurate, must be expressed to four



Determining Chlorides

**Chlorides** are measured routinely in water analyses, if, as in some areas, the possibility exists that the water supply may become polluted from industrial wastes or by salt water encroachment. Since chlorides affect the palatability of water and are difficult to remove, their presence can be a critical factor. The sample above is being titrated with silver nitrate solution, using potassium chromate as an indicator. The sample is yellow upon addition of chromate, and as silver nitrate is added, each drop shows red against yellow background. Red color persists at endpoint.

decimal places by figures such as 1.0762, the Baumé scale permits the number of decimal places to be reduced. The relation of Baumé scale to specific gravity is as follows:

For liquids heavier than water:

$$\text{Degrees Baumé} = 145 - (145 \div \text{Sp. Gr.})$$

For liquids lighter than water:

$$\text{Degrees Baumé} = (140 \div \text{Sp. Gr.}) - 130$$

A Baumé hydrometer is used to determine the specific gravity of a solution and results can be obtained to within 0.20° Baumé, which in the case of sulfuric acid is equivalent to Sp. Gr. 0.0004 at 66° Baumé, or to within 0.11%. This accuracy compares favorably with that obtained by chemical analyses and is satisfactory for most purposes. To obtain this accuracy, reliable, high-grade hydrometers must be used.

Much of the previous information regarding degrees Baumé has been taken from General Chemical Products Book. A number of conversion factor tables are available for easily obtaining metric or other equivalents. Perhaps the most widely used conversion tables for ordinary

municipal work are those issued by the Dorr-Oliver Co. If such tables are needed, write the Editor, who will forward your request.

### Chemical Terms and What They Mean

Any compound of any combination of elements will always exist in proportion to the atomic weights of the respective elements in the compound. Consider a compound of one atom of iron and one atom of sulfur. It will always combine in the proportion of 55.85 parts of iron to 32.07 parts of sulfur. In all combinations of chemicals, the relative weights are in proportion to the atomic weights.

This compound of iron and sulfur is iron sulfide. Under proper conditions 55.85 parts of iron and 32.07 parts of sulfur will combine, to form 87.92 parts of the sulfide. If there is an excess of either iron or sulfur, the excess will be unchanged and will not combine. Likewise, in preparing common salt, NaCl, there will be 23.00 parts (grams, pounds or tons) of Sodium (Na) to 35.46 parts (grams, pounds or tons) of chlorine (Cl). If there are 30 pounds of sodium to 35.46 pounds of chlorine, 7 pounds of sodium will not

combine with the chlorine, but will remain intact as sodium.

There are some chemical elements, however, that combine in more than one proportion to form more than one compound. Carbon and oxygen may unite, as previously mentioned, in the proportion of 12.01 to 16.00 to form carbon monoxide (CO), a gas that is toxic when inhaled. Carbon and oxygen may also unite to form carbon dioxide (CO<sub>2</sub>) in which case the proportions are 12.01 parts of carbon to 32.00 parts of oxygen.

These rules apply to all other compounds also. In each case a simple ratio exists between the weight of the elements, and the composition of the compound will be constant and will always be formed when the conditions are the same.

**Solution or Suspension?**—When a solid is dissolved in a liquid it forms a solution. Gases or other liquids may also be dissolved in a liquid in a like fashion to form a solution. Examples of a solid dissolved in a liquid are aluminum sulfate or sodium carbonate dissolved in water. A water solution of chlorine is an example of a gas dissolved in a liquid.

There are some substances that do not dissolve in water, such as activated carbon. Where the particles of a solid are spread or dispersed through the liquid in a very finely divided state, the mixture is called a suspension. A mixture of Fullers earth and water, such as is used in making turbidity standards, is a suspension. Finely divided materials frequently form colloidal suspensions in water. These occur naturally and cannot be settled in treatment plants without the aid of chemical coagulation.

Solutions are called dilute when they are weak, that is, when they contain only a small amount of dissolved material; or concentrated if very strong. The solution becomes saturated at the point where the liquid is unable to dissolve any more of the solid or gas. The solubility of most substances increase with rising temperatures, but a few act in reverse. This is the reason why a saturated solution may precipitate part of its dissolved solids when the temperature is lowered. A supersaturated solution may exist for a short period, until it comes into equilibrium.

For proper use, the strength of solutions must be known, and in laboratory work, solutions of a definite, known strength are used in order to make chemical calculations

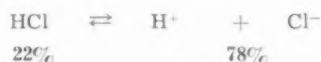
possible. The preparation of such solutions, known as standard solutions, will be discussed later.

**Mixtures and Compounds**—A mixture of two atoms of hydrogen and one atom of oxygen does not produce water, which has the chemical formula H<sub>2</sub>O. Note that if a properly proportioned mixture of these two gases is ignited, as by an electric spark, the two gases combine explosively to form water. Hydrogen gas and chlorine gas when mixed together and exposed to sunlight form a compound, HCl, or hydrochloric acid. Copper filings and powdered sulfur mixed together are only a mixture, but when the mixture is heated, it changes its character and becomes copper sulfide.

While outside agencies, as heat or light, are sometimes needed to cause these chemical reactions, this is not always the case. The mere mixing of the substances may result in the formation of the compound.

From the above it will be noted that a compound is a chemical combination of two or more substances, while a mixture is only a mechanical combination. The former cannot be readily resolved into its original parts, while the mixture can.

**Ions and Ionization**—When acids, bases and salts are dissolved in water the molecules of which they are composed are broken up into positive and negative elements or groups of elements, called radicals (or radicles), each carrying an electrical charge. This process of breaking up into simpler substances is called dissociation. These charged radicals or atoms are called ions. H<sup>+</sup> is read "hydrogen ion". For instance, hydrochloric acid dissolved in water, dissociates and the degree to which this dissociation takes place is dependent upon the concentration of the chemical in the water and on the temperature during dissociation. In a one-normal solution (to be defined later) of hydrochloric acid at 18°C, equilibrium is attained with 78 percent of the HCl dissociated. This can be expressed as:



This means that in a normal solution of HCl at a temperature of 18°C there is always 22 percent of the HCl in its original combined form or undissociated molecules, and 78 percent in the form of positive and negative ions or dissociated form. This condition is not static. The arrows indicate that action may proceed in either direction. The balance is always maintained unless

the temperature or the concentration changes. Increasing the temperature increases the percent of dissociation and vice versa. Increasing the concentration decreases the dissociation. Ionization always tends to become more complete as the dilution becomes greater.

Because only the ions in a solution enter into a chemical reaction, an acid or a base is known as strong or weak, depending on how much it is ionized in solution. The strong acids, such as hydrochloric, nitric and sulfuric, are highly ionized in solution, as are the strong bases such as sodium hydroxide and potassium hydroxide. Acetic and carbonic acids are but slightly ionized and are therefore known as weak acids.

When two or more acids and bases or salts are dissolved in the same solution, new compounds are formed. If the new compounds are all soluble in water, they intermingle, combine and dissociate and cannot again be easily separated. If, however, one of the compounds is a substance insoluble in water (as aluminum hydroxide, commonly called alum floc) it will become chemically inactive and will leave the reaction. For example, aluminum sulfate, or alum, Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, when dissolved in water, is dissociated into Al<sup>+++</sup> and SO<sub>4</sub><sup>-</sup>. If lime is present in the water as Ca(OH)<sub>2</sub> it too, will dissociate into Ca<sup>++</sup> and OH<sup>-</sup>. These ions and salts are in one solution and in contact with each other. Positive ions are attracted to the negative ions and they combine. When the Ca<sup>++</sup> and the SO<sub>4</sub><sup>-</sup> ions combine, they form CaSO<sub>4</sub> which, being soluble in water, dissociates again and continues in solution. However, when the Al<sup>+++</sup> ion combines with OH<sup>-</sup> ion, aluminum hydroxide is formed which, being insoluble in water does not again dissociate. Thus a floc or precipitate is started which grows as more molecules of aluminum hydroxide form, until it is the visible floc seen in the coagulation basin. Thus two ions have combined to form a substance which no longer dissociates and which leaves the solution.

### What pH Means

The pH of a solution is a measurement of the *intensity* of acidity, or its opposite, *alkalinity*. It measures the *pressure* tending to drive a chemical reaction. The term *alkalinity*, when used in connection with pH, should not be confused with the use of the same term to denote the amount or weight of certain dissolved alkaline minerals



in water. The pH is otherwise defined as the logarithm of the reciprocal of the hydrogen ion concentration, and can be mathematically expressed as follows:

$$\text{pH} = \log \frac{1}{[\text{H}^+]}$$

The term  $[\text{H}^+]$  is read, "hydrogen ion concentration" and its units are moles per liter. 1 mole per liter equals 1 gram molecular weight of the material in 1 liter of solution. The pH scale runs from 0 to 14 with 7 being a neutral value. A solution is acidic when pH is lower than 7 and basic when pH is between 7 and 14. When pH is as low as 4 the solution is very strongly acid and conversely when pH is 11 or more it is strongly anti-acid. Adding acids lowers the H and adding alkalis raises the pH. Pure water has a pH of 7.0.

pH measures the  $[\text{H}^+]$  and in a similar manner pOH measures the  $[\text{OH}^-]$ , read "hydroxyl ion concentration". If the pH of a solution is known the pOH can be easily determined because  $\text{pH} + \text{pOH} = 14$ . For instance, if the pH of an acid is 4.2 then the  $\text{pOH} = 14 - 4.2 = 9.8$ . Units of pOH are the same as for pH.

Alkalinity and acidity of water are amounts of acids or bases present and are measured in ppm while pH is measured on an arbitrary scale from 0 to 14 and is a measure of chemical activity or intensity.

pH is a very important factor in chemical treatment of water and sewage because it definitely affects the efficiency of chemical reactions. Often the pH is adjusted to bring about more efficient use of coagulating chemicals.

Example: The hydrogen ion concentration of a solution is 0.00005 moles per liter. What is its pH and is it acid or base? Solution:

$$\text{pH} = \log \frac{1}{[\text{H}^+]} = \log \frac{1}{.00005} = \log 20,000 = 4.301 \text{ and the solution is obviously a strong acid.}$$

### How Chemicals Combine

The principles governing the combination of elements to form compounds have already been stated briefly. The atomic and molecular weights are used for determining how much of each element is required to form the desired compound, and also as a check on computations, since both sides of a chemical equation must balance. The procedures, explained in connection with the combination of elements to make compounds, apply also to the addition of compounds

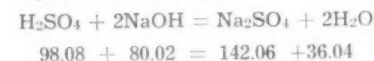
to produce other desired compounds. For instance if quicklime and sulfuric acid are combined, the results will be calcium sulfate and water. The chemical reactions involved are:



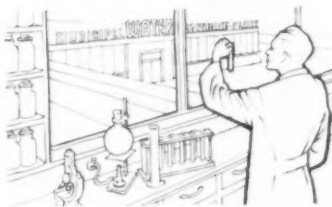
The following form illustrates the method of using atomic weights to compute molecular weights and to balance the equation:

$\text{H}_2\text{SO}_4$ :	2H = 2.02	
	S = 32.06	
	4O = 64.00	98.08
	O = 16.00	56.08
CaO:	Ca = 40.08	
Total,		
$\text{H}_2\text{SO}_4 + \text{CaO} =$		154.16
$\text{CaSO}_4$ :	Ca = 40.08	
	S = 32.06	
	4O = 64.00	136.14
$\text{H}_2\text{O}$ :	2H = 2.02	
	O = 16.00	18.02
Total,		
$\text{CaSO}_4 + \text{H}_2\text{O} =$		154.16

Thus, the atomic weights on both sides of the equation total 154.16 indicating the equation is correct. Similarly, when sulfuric acid,  $\text{H}_2\text{SO}_4$ , is added to sodium hydroxide, NaOH, producing sodium sulfate,  $\text{Na}_2\text{SO}_4$ , and water,  $\text{H}_2\text{O}$ , it will be found that both sides of the equation balance thus:



In making these combinations, all of the elements composing each compound must be properly com-



bined, with none left over. The weight ratio, as shown, is also important in solving various problems in feeding chemicals. For instance, how much sulfuric acid would be required to combine with 100 pounds of CaO, and how much gypsum,  $\text{CaSO}_4$ , would be formed?

From the reaction above 98.08 pounds of sulfuric acid are required for combining with 56.08 pounds of CaO. Therefore, 100 pounds of CaO will require  $100 \times 98.08 \div 56.08 = 175$  pounds of sulfuric acid, and this will produce  $100 \times 136.14 \div 56.08 = 243$  pounds of  $\text{CaSO}_4$ . The remainder will be water, as shown previously, amounting to  $100 \times 18.02 \div 56.08$ , or 32 pounds.

**The Water in Chemicals**—Some chemical formulas are written thus:  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ . The  $\text{FeSO}_4$  indicates ferrous sulfate. The  $\text{H}_2\text{O}$  indicates that the compound is a hydrate, that it contains water of hydration or crystallization. The 7 indicates the amount of water it contains. Similarly, the commercial grade crystal of aluminum sulfate has the formula  $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$  but you can buy alum with either more or less water content. Chemically pure aluminum sulfate has the formula  $\text{Al}_2(\text{SO}_4)_3$  and a molecular weight of 342.12 while with the 18 molecules of water its molecular weight is 666.41. In other words the hydrate form of alum is nearly half water. The water content is important in purchasing by weight, and also in computing dosages by weight of crystals. Aluminum sulfate should be purchased on its content of  $\text{Al}_2\text{O}_3$ , and ferric chloride and ferrous sulfate on their iron contents.

**Endings and Beginnings**—As already stated, the force that holds the elements together into compounds is electrical in nature. Since those elements having like charges will not combine, compounds are made up of electro-positive and electro-negative elements. Hydrogen and the metals are positive and chlorine, oxygen, etc., are negative. When joined in a compound, the name of the compound is formed by the name of the electro-positive element followed by the name of the electro-negative, with the suffix or ending "ide", as sodium chloride, NaCl; calcium oxide, CaO; and aluminum oxide,  $\text{Al}_2\text{O}_3$ . When two elements form more than one compound, a numerical prefix is used on the electro-negative term, as carbon monoxide, CO; carbon dioxide,  $\text{CO}_2$ ; phosphorous trioxide,  $\text{P}_2\text{O}_3$ ; and phosphorous pentoxide,  $\text{P}_2\text{O}_5$ .

When elements form more than one oxide, the suffix "ous" is used to indicate the lower condition of oxidation, and the suffix "ic" to indicate the higher condition. For example, cuprous oxide,  $\text{Cu}_2\text{O}$ , and cupric oxide, CuO. The same suffixes are used in the same way with acids. Sulfurous acid,  $\text{H}_2\text{SO}_3$ , is a combination of sulfur dioxide and water. Similarly sulfuric acid,  $\text{H}_2\text{SO}_4$ , is a combination of sulfur trioxide,  $\text{SO}_3$ , and water.

The terminations "ite" and "ate" are used to indicate the salts derived from acids terminating in "ous" and "ic", as sodium sulfite,  $\text{Na}_2\text{SO}_3$ , and sodium sulfate,  $\text{Na}_2\text{SO}_4$ .

In some cases there are compounds still lower or higher in the series than those employing "ous"



or "ic" endings. The prefix "hypo" is used to distinguish those that are lowest, and the prefix "per" those that are highest. Here is an example, in order of oxygen content: hypochlorous,  $\text{HClO}$ ; chlorous,  $\text{HClO}_2$ ; chloric,  $\text{HClO}_3$ ; and perchloric,  $\text{HClO}_4$  acids. Sodium salts of these acids are hypochlorites,  $\text{NaClO}$ ; chlorites,  $\text{NaClO}_2$ ; chlorates,  $\text{NaClO}_3$ ; and perchlorates,  $\text{NaClO}_4$ .

### The Chemicals You May Use

As previously stated, only a few chemicals are normally used in water and sewage treatment plants. These may be grouped under gases, acids and metals, (which include the bases), for a brief consideration.

**Chlorine:** Symbol  $\text{Cl}_2$ , atomic weight 35.46, is 2.49 times as heavy as air. It is a greenish-yellow gas which under pressure is converted to a liquid. Its odor is detectable at a concentration of 3.5 ppm in air; 4 ppm is the maximum concentration that can be breathed for one hour without bad effects; 15 ppm causes throat irritation; 30 ppm causes coughing; 40 to 60 ppm is dangerous when inhaled for 30 minutes or more; and 1,000 ppm (one-tenth of one per cent) may produce death after 5 minutes exposure.

**Oxygen:** Symbol  $\text{O}_2$ ; specific gravity 1.015; atomic weight 16.00. Oxygen is a colorless, odorless gas which combines readily with many elements to form numberless compounds, both organic and inorganic.

**Hydrogen:** Symbol  $\text{H}_2$ ; specific gravity 0.07; atomic weight 1.01. Hydrogen is the lightest known material, is a constituent of all acids, and combines with many other elements.

**Hydrogen Sulfide:** Symbol  $\text{H}_2\text{S}$ ; specific gravity 1.190; molecular weight 34.08; a colorless gas. The odor, in low concentrations, is that of rotten eggs. The maximum safe concentration with a gas mask is 20 ppm. 700 ppm causes death in a short time and 1000 ppm causes death almost instantly.

**Nitrogen:** Symbol  $\text{N}_2$ ; specific gravity 0.97; atomic weight 14.01. Nitrogen is an odorless, colorless and tasteless gas.

**Carbon Dioxide:** Symbol  $\text{CO}_2$ ; specific gravity 1.529; molecular weight 44.01.

**Carbon Monoxide:** Symbol  $\text{CO}$ ; specific gravity 0.967; molecular weight 28.01; an odorless, colorless, poisonous gas.

**Ammonia:** Symbol  $\text{NH}_3$ ; specific gravity 0.596; molecular weight 17.04.

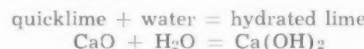
**Hydrochloric** or muriatic acid,  $\text{HCl}$ , when absorbed in water forms hydrochloric acid. The term hydrochloric acid is frequently applied to either the gas or the solution in water, although the correct term for the gas is hydrogen chloride. The standard grade has a specific gravity of 1.178 to 1.188 and a strength of 35% to 37%.

**Nitric Acid,**  $\text{HNO}_3$ , is a clear, colorless or yellow liquid, which is extremely corrosive. It is subject to decomposition by sunlight, turning brown on exposure. Nitric acid, 36° Baumé, contains approximately 52.3%  $\text{HNO}_3$  but stronger concentrations are available.

**Sulfuric acid,**  $\text{H}_2\text{SO}_4$ , is a clear or slightly cloudy, heavy liquid with an extremely corrosive action. Specific gravity is from 1.835 to 1.840. The most commonly used grade is 66° Baumé, which has a strength of 93.2%, but other concentrations are available. The CP (chemically pure) grades are usually 95% to 96%  $\text{H}_2\text{SO}_4$ , the remainder being water, which sulfuric acid takes up readily from the atmosphere. For this reason, solutions may lose strength on standing. When water is added to concentrated sulfuric acid, violent heat is generated. *The acid should always be added to the water carefully in small quantities.*

**Carbonic acid,**  $\text{H}_2\text{CO}_3$ , is a weak acid, used in most charged water and soft drinks. It combines readily with sodium, calcium and magnesium to form carbonates and bicarbonates.

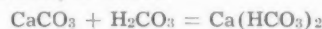
**Calcium,**  $\text{Ca}$ , atomic weight 40.08, is an alkaline-earth metal. A common compound of calcium is  $\text{CaO}$  or quicklime. When water is added, the result is hydrated lime,  $\text{Ca}(\text{OH})_2$ . The reaction:



When carbon dioxide ( $\text{CO}_2$ ) comes in contact with lime, it forms calcium carbonate, ( $\text{CaCO}_3$ ). When it combines with hydrated lime, it forms  $\text{CaCO}_3$  and water.



If still more  $\text{CO}_2$  is added, it combines with water to form carbonic acid,  $\text{H}_2\text{CO}_3$ , and bicarbonate is formed, as follows:



**Magnesium,**  $\text{Mg}$ , atomic weight 24.32, is often found in association with calcium. It enters generally into the same compounds as calcium. Magnesium and calcium are responsible for most of the carbonate hardness in water.

**Sodium,**  $\text{Na}$ , atomic weight 23.00, is an alkali metal. Perhaps its principal use in water purification is in sodium carbonate,  $\text{Na}_2\text{CO}_3$ , soda ash, which is used in the same way lime is used to provide alkalinity and to correct corrosiveness or an acid condition in water. It is used as a softening agent for removing non-carbonate hardness. Other forms are sodium sulfate, ( $\text{Na}_2\text{SO}_4$ ); sodium chloride or common salt ( $\text{NaCl}$ ), sometimes used as a brine; sodium hydroxide or caustic soda, ( $\text{NaOH}$ ); sodium thiosulfate, ( $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ ) which is used to remove an excess of chlorine following superchlorination; sodium silicate or water glass ( $\text{Na}_2\text{Si}_2\text{O}_5$  is one of several formulas) is used for coating the inside of water pipes to prevent corrosion; sodium hexa-meta phosphate, an inhibitor of calcium and other deposits; and calgon which is used to prevent formation of calcium carbonate scale, to control corrosion, and to stabilize dissolved iron. Sodium aluminate, ( $\text{Na}_2\text{Al}_2\text{O}_4$ ), is another sodium chemical used as a coagulant. It is advantageous for certain uses, primarily with water used for boilers or for steaming purposes.

**Potassium,**  $\text{K}$ , atomic weight 39.10 is an alkali metal resembling sodium in many of its characteristics.

**Aluminum,**  $\text{Al}$ , atomic weight, 26.97. Its main use is in  $\text{Al}_2(\text{SO}_4)_3$ , aluminum sulfate, a coagulant. Theoretically the crystal formula is  $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$ , but as produced commercially the formula is  $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$ . As already stated, the  $\text{H}_2\text{O}$  indicates that the compound is a hydrate, contains water of crystallization, and the 14 or 18 indicates the amount of water it contains. Aluminum sulfate, commonly called "filter alum", is used for coagulation in both water and sewage treatment. The floc that is formed is aluminum hydroxide. The reactions in coagulation will be explained under "Coagulation."

**Liquid Alum** is essentially a 49 percent solution of dry alum normally delivered at a strength of 8.3 percent  $\text{Al}_2\text{O}_3$ . It has several important advantages over dry alum, but shipping costs are such, due to the fact that a ton of water is shipped for each ton of dry material, that the water plant must be not more than 50 miles from the point of manufacture. Within this shipping range, there is a lower delivered cost; the equipment for applying the liquid alum is less expensive; and labor costs are reduced. There is usually a reduction in dust and often a more accurate control

of feeding is possible. Shipment and storage is made in lead, concrete, rubber or wood-lined tanks. Solution lines may be of chemical lead, polyvinyl chloride, uscolite, rubber, rubber-lined steel or saran lined steel. Valves may be of duriron or the rubber lined diaphragm type. Where pumping is needed, wetted parts should be Durimet 20, Alloyco 20, Worthite or Elcomet K. Feeding presents no unusual problems.

The strength as  $Al_2O_3$  is 8.3 percent and on a dry basis 48.8 percent of  $Al_2(SO_4)_3 \cdot 14 H_2O$ . Specific gravity is about 1.34 and Baumé 36.5; a gallon weighs 11.2 pounds and contains 5.4 pounds of dry alum. Freezing point is about 17°F.

Ammonia alum is sometimes used for coagulation, but it is economical only under special conditions. The formula for ammonia alum, which is a true alum, is  $Al_2(SO_4)_3 \cdot (NH_4)_2SO_4 \cdot 24H_2O$ . Ammonia alum dissolves slowly. Based upon the  $Al_2O_3$  content, the cost is greater than for ordinary or filter alum.

**Iron**, Fe, atomic weight 55.85, is used in water and sewage coagula-

tion in a number of forms, including the following:

$FeSO_4$  ferrous sulfate  
 $Fe_2(SO_4)_3$  ferric sulfate  
 $FeCl_3$  ferric chloride

Ferrous sulfate, frequently called copperas, should not be confused with copper sulfate ( $CuSO_4$ ). As commonly purchased, ferrous sulfate has the formula  $FeSO_4 \cdot 7H_2O$ . When used in coagulation, lime must usually be added to provide the alkalinity necessary for reaction, and oxygen must be available to change, or oxidize, the  $Fe(OH)_2$  to  $Fe(OH)_3$ , which is the desired coagulant.

If 3 parts of chlorine are added to 6 parts of  $FeSO_4$ , 2 parts of ferric sulfate and 2 parts of ferric chloride are produced.

It will be an interesting problem for the student to compute how much chlorine is needed to react with each pound of ferrous sulfate in this solution, remembering that the formula for ferrous sulfate is  $FeSO_4 \cdot 7H_2O$  and that an allowance must be made for the weight of the water in the hydrate. He should use the atomic weights previously given

and either neglect the right half of the equation or allow for  $42H_2O$  in balancing it, this being due to the  $7H_2O$  contained in each unit of the  $FeSO_4$ .

**Ferric chloride** is available in lump form, the formula being  $FeCl_3 \cdot 6H_2O$ , and also as a solution. The concentration in solution varies because of the relation between temperature and crystallization, and is about 40 percent, falling to 35 percent in cold weather.

### Other Chemicals

**Hypochlorites** of calcium or sodium are used for various purposes, as for disinfecting newly laid water mains, chlorinating small water supplies and in swimming pool sanitation. The typical formula for calcium hypochlorite is  $Ca(ClO)_2$ , and for sodium hypochlorite is  $NaClO$ .

**Activated carbon** differs from most other chemicals in that its value is measured by what it accomplishes rather than its chemical analysis. The action of activated carbon is by adsorption. Note that this is not absorption. When activated carbons adsorb impurities from solution, these impurities are actually removed by being attached to the carbon molecule rather than changed by chemical reaction from one compound to another. The primary application of activated carbon in the water and sewage field is for control of tastes and odors.

**Sodium hydroxide**,  $NaOH$ , or caustic soda, is used generally as an alkali to adjust pH.

**Copper sulfate**,  $CuSO_4$ , is used in algae control.

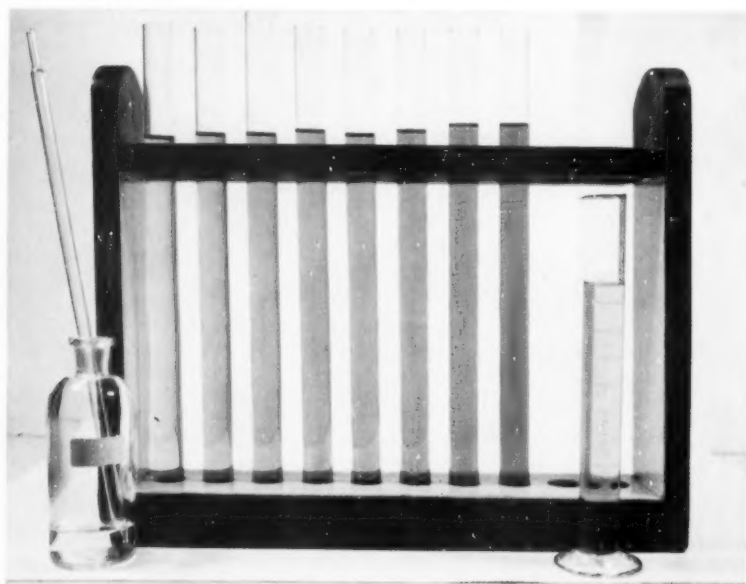
**Ammonia**,  $NH_3$ , a gas, is used with chlorine for disinfection in water treatment. Its use in this field is decreasing.

**Chloramines**,  $NH_2Cl$  and  $NHCl_2$  are used in disinfection of water. These are formed by marginal chlorination in the presence of the  $NH_3$  radical.

**Sulfur dioxide**, a gas,  $SO_2$  is used as a strong oxidizing agent. Its main use is in reconditioning sand in rapid sand filters.

**Ozone**,  $O_3$ , a very unstable oxidizing material is formed by passing air through a high-voltage electric field. It is used in disinfection and odor control work.

**Fluorides**. The  $F^-$  ion is being added to waters to help prevent dental caries in an increasing number of communities. Indications are that a concentration of fluorine between 1.0 and 1.5 ppm prevents from 50-60 percent of dental caries in children who use fluoridated water from birth. The fluorides are



Color Standards in Nessler Tubes

Many of the colorimetric determinations in water and sewage analyses involve the use of standards which show gradations of color, depending on the concentration of the substance present. Standards may be prepared, using known amounts of the ion being determined. The same indicator is added to the standards and to the sample to be tested. The color intensity developed in the latter is then compared with those of known concentration. Nessler tubes are usually employed for this comparison. These standards are for measuring the concentration of iron in water.

added by means of one of the three following chemicals: sodium fluoride, NaF; sodium silicofluoride, Na<sub>2</sub>SiF<sub>6</sub>; or fluosilicic acid, H<sub>2</sub>SiF<sub>6</sub> (also called hydrofluosilicic acid).

**Ion exchange materials** are such loosely bound substances, chemically speaking, that when water is passed through the exchange material the anions or cations may be removed. The action is similar to that of activated carbon in some respects, and in all cases is a reversible reaction. After the given exchange material has been exhausted it may be regenerated to its original state and will then be ready for reuse.

### "Standard" Solutions

A **standard solution** is one that contains a *known* weight of the substance under consideration in a definite volume of solution. Standard solutions are an absolute necessity in making chemical analyses, and such solutions are usually expressed in terms of the *normal* system. To understand fully the normal system, some explanations and a few definitions and examples are necessary.

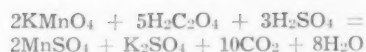
The **gram-atomic weight** of a substance is the atomic weight of that substance expressed in grams. For example, from Table I, the atomic weight of sulfur is 32.06 and the gram-atomic weight is also 32.06 grams. The atomic weight of sodium is 23.00 and the gram-atomic weight is 23.00 grams.

The **gram-molecular weight** of a substance or compound is the sum of the gram-atomic weights of the elements that make it up. For instance, the molecular weight of sulfuric acid, from Table 3, is  $2.02 + 32.06 + 64.00 = 98.08$ , and the gram-molecular weight is 98.08 grams. The gram-molecular weight of sodium carbonate, Na<sub>2</sub>CO<sub>3</sub>, is  $46.00 + 12.01 + 48.00 = 106.01$  grams.

The **gram-equivalent weight** of a compound is computed from the above. For acids, the gram-equivalent weight is the gram-molecular weight divided by the number of replaceable hydrogen atoms that they contain. For instance, H<sub>2</sub>SO<sub>4</sub> contains two replaceable hydrogen atoms, and the gram-equivalent weight is the gram-molecular weight divided by 2. That is, it is  $98.08 \div 2 = 49.04$  grams. For bases, the gram molecular weight is divided by the number of hydrogen or hydroxyl ions entering into the neutralizing reaction. For instance, Na<sub>2</sub>CO<sub>3</sub> has the equivalent of two ionizable hydrogen atoms, that is the two Na

ions can be replaced by two H ions, and the gram-equivalent weight is therefore  $106.01 \div 2 = 53.00$ .

The gram-equivalent weights of various compounds are shown in Table 3. These gram-equivalent weights are given in most chemistry texts and handbooks, or they may be computed. Considering aluminum sulfate, the molecular weight is ob-



### A "Normal" Solution

A one-normal solution contains one gram-equivalent weight of that substance in a liter of solution. A normal solution of H<sub>2</sub>SO<sub>4</sub>, see Line 20 of Table 3, contains 49.04 grams

Table 3—Molecular and Gram-Equivalent Weights

Compound	Formula	Molecular Weight	Gram-Equivalent Weight
Aluminum sulfate	Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	342.12	57.02
Ammonium hydroxide	NH <sub>4</sub> OH	35.05	35.05
Calcium carbonate	CaCO <sub>3</sub>	100.09	50.04
Calcium hydroxide	Ca(OH) <sub>2</sub>	74.10	37.05
Calcium oxide	CaO	56.08	28.04
Calcium sulfate	CaSO <sub>4</sub>	136.15	68.07
Ferric chloride	FeCl <sub>3</sub>	162.22	54.07
Ferrous sulfate	FeSO <sub>4</sub>	151.92	75.96
Hydrochloric acid	HCl	36.47	36.47
Hydrogen sulfide	H <sub>2</sub> S	34.09	17.04
Magnesium hydroxide	Mg(OH) <sub>2</sub>	58.34	29.17
Magnesium sulfate	MgSO <sub>4</sub>	120.38	60.19
Nitric acid	HNO <sub>3</sub>	63.02	63.02
Potassium permanganate	KMnO <sub>4</sub>	158.03	31.61*
Silver nitrate	AgNO <sub>3</sub>	169.89	169.89
Sodium carbonate	Na <sub>2</sub> CO <sub>3</sub>	106.01	53.00
Sodium chloride	NaCl	58.45	58.45
Sodium fluoride	NaF	42.00	42.00
Sodium hydroxide	NaOH	40.01	40.01
Sulfuric acid	H <sub>2</sub> SO <sub>4</sub>	98.08	49.04

\* Oxidation reduction action in acid medium

tained by adding the atomic weights of the elements that make it up. The number of replaceable hydrogen atoms, or their equal, can be determined by inspection. For instance we know that SO<sub>4</sub> and 2H combine to form H<sub>2</sub>SO<sub>4</sub>. Therefore SO<sub>4</sub> will combine with two hydrogen ions. In Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, the Al<sub>2</sub> combines with three SO<sub>4</sub> radicals and therefore it must be equivalent to 6 H ions. Thus the gram-equivalent weight is  $342.12 \div 6 = 57.02$ .

There are special rules which apply to oxidation-reduction reactions and equivalent weight of one of the compounds involved. For instance, potassium-permanganate has a gram-equivalent weight, in a common oxidation-reduction reaction, which is one-fifth of the gram-molecular weight. This is because the valence of the Mn ion has changed from +7 in KMnO<sub>4</sub> to +2 in MnSO<sub>4</sub>. This change in valence of 5 gives the ratio between the gram-molecular and gram-equivalent weights in this case. Part of the reaction involving the standardization of potassium permanganate is represented by the following formula which shows the change in valence of 5 for the manganese ion:

of pure sulfuric acid diluted to one liter of solution. Usually the pure acid is added to distilled water to make up the required quantity of one liter. Likewise a one-normal solution of calcium carbonate contains 50.04 grams of the pure calcium carbonate in one liter of solution. A milliliter (or a liter, quart, etc.) of sulfuric acid solution will exactly neutralize a milliliter (or liter, quart, etc.) of the calcium carbonate solution.

The whole objective of making normal solutions is to provide solutions of known normality. Then we know that two compounds which react with each other will exactly neutralize each other if their normality and volumes are equivalent for both compounds. For instance 50 ml. of 0.5N H<sub>2</sub>SO<sub>4</sub> will just exactly neutralize 50 ml. of 0.5N NaOH, or 50 ml. of 0.5 N H<sub>2</sub>SO<sub>4</sub> will exactly neutralize 100 ml. of 0.25N NaOH. Whenever two solutions react to neutralize each other there is a general formula which expresses this action: (ml. of solution A) x (Normality of solution A) = (ml. of solution B) x (Normality of solution B). Abbreviated this gives us  $V_1N_1 = V_2N_2$ , where V = volume and N



= normality.  $V_1$  and  $N_1$  may refer to the unknown,  $V_2$  and  $N_2$  then refers to the standard.

N

A 0.02N, a fiftieth normal or a  $\frac{1}{50}$  solution of sulfuric acid all have the same concentration. Each will contain 1/50 of 49.04 grams or 0.98 grams of pure sulfuric acid per liter of solution. In the case of calcium carbonate, one liter of N/50 solution will contain 50.05/50 or almost exactly 1.00 gram of pure calcium carbonate.

A tenth normal solution of sulfuric acid will contain 4.904 grams of pure acid diluted to one liter of solution. A normal solution contains 49.04 grams and a 10N solution will contain 490.4 grams etc.

The preparation of these normal solutions must begin with some material which can be obtained in a chemically pure (C.P.) state. The best grade of anhydrous sodium carbonate, C.P., is usually employed initially. A solution of normal, or less than normal strength, is obtained by carefully weighing out the required amount, to the nearest ten-thousandth of a gram, or the nearest tenth of a milligram. It is then diluted to a convenient volume of perhaps 80 ml and is titrated with an acid of unknown normality. The volume of acid needed to neutralize the sodium carbonate is carefully recorded by means of a burette. From this manipulation the normality of the acid can be computed and we have a standardized acid solution. The procedure requires some practice and skill in handling chemicals and precision chemical laboratory equipment. A particularly clear description of the detail procedure to be followed is given in Theroux, Eldridge and Mallmann's text, "Analysis of Water and Sewage". It is better for the small sewage or water plant laboratory, without a trained chemist, to purchase solutions of definite strength already standardized, or ampoules containing these solutions ready for use.

Solutions may change in strength as time passes, and they should be checked by titrating them against solutions of known strength, and their variation from normal determined and corrected for in subsequent calculations. Titration means the addition of measured, small quantities of the standard until a definite endpoint is reached. In actual laboratory practice, solutions are not always kept at exact normal strength, but their actual strength, or normality, is known and

proper allowance is made in the computations.

### "Molar" Solutions in Chemistry

A molar solution of a substance is a solution that contains one gram-molecular weight of the substance diluted to one liter of solution. As already stated, the gram-molecular weight is the sum of the gram-atomic weights of the elements that make up the compound. Molar solutions are indicated by strength in the same way that normal solutions are indicated; that is 0.01 M or M/100; M/50; 10M, etc.

A molar solution of sulfuric acid contains 98.08 grams of the pure acid in one liter. A 0.02 M solution contains 1.9616 grams and a 0.01 M solution contains 0.98 grams, or ex-

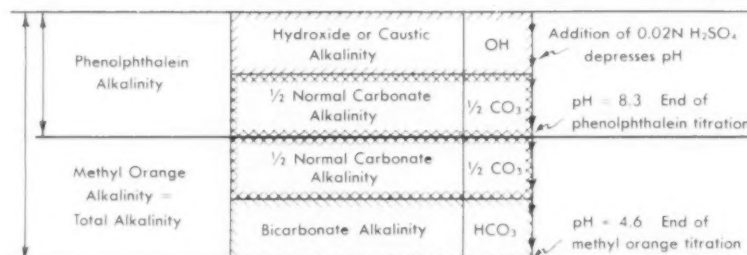
actly the same as a N/50 solution. Don't confuse the M's and the N's. In the case of  $H_2SO_4$ ,  $Na_2CO_3$  and other compounds that have two replaceable hydrogen atoms, or their equal, the Molar solution is twice as strong as the Normal solution, and a M solution equals a 2N solution. In the case of those compounds that have but one replaceable hydrogen atom, or equal, as  $HNO_3$ ,  $HCl$  and  $NaOH$ , the gram equivalent weight is the same as the gram molecular weight, and the Molar and Normal solutions are of equal strength.

A molar solution is a gram-molecular weight of a substance dissolved in one liter of solvent, thus making more than one liter of solution. These solutions are weaker than molar solutions, should not be confused with molar solutions and are not used a great deal in this type of work.

### Making Chemical Tests

It is not the purpose of this brief text to explain the procedure in making chemical tests, for which "Standard Methods" or the excellent text, "Analysis of Water and Sewage" by Theroux, Eldridge and Mallman should be followed, but it is desirable to be familiar with the various terms used in connection

with them. General methods employed in testing include qualitative analyses, which are made to determine what elements or compounds are present, and quantitative analyses which are made to determine the amounts present. Before attempting to determine the amount of chemical compounds present, it is necessary to determine the kinds of compounds that are in the sample. In many cases, a qualitative analysis is all that is necessary, but in other cases it will serve as a guide to the methods to be employed for further testing. Example of a very simple form of qualitative analysis is the addition of orthotolidine indicator solution to water to determine if chlorine is present. The appearance of color in-



● ALKALINITY diagram shows pH values at endpoints and range of the indicators.

actly the same as a N/50 solution. Don't confuse the M's and the N's. In the case of  $H_2SO_4$ ,  $Na_2CO_3$  and other compounds that have two replaceable hydrogen atoms, or their equal, the Molar solution is twice as strong as the Normal solution, and a M solution equals a 2N solution. In the case of those compounds that have but one replaceable hydrogen atom, or equal, as  $HNO_3$ ,  $HCl$  and  $NaOH$ , the gram equivalent weight is the same as the gram molecular weight, and the Molar and Normal solutions are of equal strength.

A molar solution is a gram-molecular weight of a substance dissolved in one liter of solvent, thus making more than one liter of solution. These solutions are weaker than molar solutions, should not be confused with molar solutions and are not used a great deal in this type of work.

Gravimetric quantitative analyses are made by weighing the amount of compound that is present in the sample, the compound first being changed by appropriate methods so that it is insoluble and easily separated. For example, the determination of sulfur in a sample of sewage involves changing the sulfur to sulfate and combining it with a soluble salt of lead or barium. The resulting compound is insoluble and can be removed by filtration and weighed, permitting the amount of sulfur in the original sample to be calculated. Volumetric quantitative analyses are made by adding a chemical of known strength, or Normality, to an exact quantity of the sample. The volume of the standard reagent required for the desired reaction permits the amount of chemical, or unknown, in the sample to be calculated. This is where the formula  $V_1N_1 = V_2N_2$  is used. For example, the alkalinity of water is determined by adding N/50 sulfuric acid to a 100 ml sample (after phenolphthalein or methyl orange indicator has been added) until a color



change is noted. These indicators change color at certain pH values and we call these end points. The alkalinity of the water, expressed in parts per million, is 10 times the number of milliliters of N/50 sulfuric acid required to produce the color change.

Colorimetric quantitative analyses involve the determination of the amount of unknown chemical in the sample by matching the color produced by adding the same chemical to a set of samples containing a known amount of the chemical being checked, or by artificial color standards. This method is valuable in determining the presence of minute quantities of chemicals. For example, nitrites in water or sewage can be determined by adding a chemical that produces a distinct color in the sample. This color is matched with that produced by adding the same chemical to previously prepared tubes containing known amounts of nitrites.

Turbidimetric analyses are used in determining the amount of turbidity present in a sample by matching it with a series of suspensions of known turbidity. This is illustrated in the use of the familiar turbidity standards.

### Chemistry in Water Treatment

In water treatment, chemistry is used in the determination of alkalinity, in softening, in coagulation, in corrosion control, in fluoridation control, in chlorination and in various other tests.

**Alkalinity, salinity and hardness** are caused by the presence of certain chemical compounds in the water. A determination of the kinds and amounts of these may be necessary for proper treatment procedures. Compounds that cause alkalinity, hardness and salinity may be grouped as follows:

Those that cause alkalinity only:

Potassium carbonate,  $K_2CO_3$   
Potassium bicarbonate,  $KHCO_3$   
Sodium carbonate,  $Na_2CO_3$   
Sodium bicarbonate,  $NaHCO_3$

Those that cause both alkalinity and carbonate hardness:

Calcium carbonate,  $CaCO_3$   
Calcium bicarbonate,  $Ca(HCO_3)_2$   
Magnesium carbonate,  $MgCO_3$   
Magnesium bicarbonate,  
 $Mg(HCO_3)_2$

It will be noted that the potassium and sodium compounds do not cause hardness, but that all carbonates and bicarbonates cause alkalinity, while all calcium and magnesium compounds cause hardness, whether

in the carbonate, bicarbonate, sulfate or chloride form.

Those that cause both salinity and non-carbonate hardness:

Calcium sulfate,  $CaSO_4$   
Calcium chloride,  $CaCl_2$   
Magnesium sulfate,  $MgSO_4$   
Magnesium chloride,  $MgCl_2$

Other salts that cause salinity, but not hardness:

Potassium sulfate,  $K_2SO_4$   
Potassium chloride,  $KCl$   
Potassium nitrate,  $KNO_3$   
Sodium sulfate,  $Na_2SO_4$   
Sodium chloride,  $NaCl$   
Sodium nitrate,  $NaNO_3$

Generally speaking carbonates, bicarbonates and hydroxides cause alkalinity. Caustic alkalinity occurs when there is an excess of lime,  $Ca(OH)_2$ , in the water and this excess may precipitate in the distribution system or on the sand filter beds as  $CaCO_3$ . Caustic alkalinity does not occur naturally.

Acidity in water is caused by free  $CO_2$ , by mineral acids, by iron or aluminum sulfates, by acid mine drainage and by some other less common compounds.

**Alkalinity tests** are run using two indicators, phenolphthalein and methyl orange. The test is performed by adding phenolphthalein indicator then titrating with 0.02N,  $H_2SO_4$  to an end point. To an identical sample is added methyl orange indicator, then it is titrated with 0.02N,  $H_2SO_4$  to its end point. The phenolphthalein titration measures all the hydroxide alkalinity, half of the carbonate alkalinity and none of the bicarbonate alkalinity. The methyl orange alkalinity measures all types of alkalinity and includes the alkalinity measured by phenolphthalein. Recall that alkalinity is due to hydroxides, carbonates and bicarbonates and that hydroxide and bicarbonate cannot both exist at the same time in a sample. All alkalinity is measured in terms of  $CaCO_3$ . The accompanying diagram illustrates the range of the indicators and the value of the pH at the two end points. Frequent reference to this diagram will aid in understanding the following examples of the five different combinations of the three kinds of alkalinity.

(1) If the alkalinity to phenolphthalein is 0, that is, there is no color reaction to the addition of the phenolphthalein indicator solution, there is no caustic alkalinity and no carbonate alkalinity, but the alkalinity to methyl orange as shown by the test represents the bicarbonate alkalinity.

Example: Alkalinity to phenol-

phthalein is 0.0 ppm; and to methyl orange is 18.5 ppm. Caustic alkalinity is 0; carbonate alkalinity is 0; and bicarbonate alkalinity is 18.5 ppm.

(2) When the alkalinity to phenolphthalein is less than one-half the alkalinity to methyl orange, there is no caustic alkalinity; the carbonate alkalinity is twice the phenolphthalein alkalinity; and the bicarbonate alkalinity is the methyl orange alkalinity minus twice the phenolphthalein alkalinity.

Example: Alkalinity to phenolphthalein is 28.0 ppm; and to methyl orange 86.0 ppm. Caustic alkalinity is 0; carbonate alkalinity is 56.0 ppm. and bicarbonate alkalinity is  $86 - (2 \times 28) = 30$  ppm.

(3) When the phenolphthalein alkalinity is exactly one-half of the methyl orange alkalinity, the caustic alkalinity is 0, the carbonate alkalinity is the same as the methyl orange alkalinity, and the bicarbonate alkalinity is 0.

Example: Phenolphthalein alkalinity is 72.0 ppm and methyl orange alkalinity is 144.0 ppm. The caustic alkalinity is 0.0 ppm; the carbonate alkalinity is 144.0 ppm; and the bicarbonate alkalinity is 0.0 ppm.

(4) When the phenolphthalein alkalinity is more than one-half of the methyl orange alkalinity, caustic alkalinity is twice the phenolphthalein alkalinity minus the methyl orange alkalinity; the carbonate alkalinity is twice the difference between the methyl orange and phenolphthalein alkalinities; and the bicarbonate alkalinity is 0.

Example: The phenolphthalein alkalinity is 150 ppm; the methyl orange alkalinity is 196 ppm. The caustic alkalinity is  $(2 \times 150) - 196 = 104$  ppm; the carbonate alkalinity is  $2 \times (196 - 150) = 92$  ppm; bicarbonate alkalinity is 0.

(5) When the phenolphthalein and methyl orange alkalinities are the same all the alkalinity is caustic alkalinity and carbonate and bicarbonate alkalinities are 0.

Example: Phenolphthalein alkalinity is 120; alkalinity to methyl orange is 120. Hydroxide alkalinity is 120, and carbonate and bicarbonate alkalinities are 0.

The utility and method of use of alkalinity determinations will be indicated in material presented hereafter.

### Chemistry of Water Softening

Hardness is of two kinds, carbonate hardness, sometimes called temporary hardness because part of it is removable as scale by boiling; and non-carbonate hardness, also

called permanent hardness because it is not affected by boiling. Carbonate hardness, as already stated, is due to calcium and magnesium carbonates and bicarbonates; the calcium carbonate is insoluble except for a residual of between one and two grains per gallon, so that partial softening is obtained by changing these bicarbonates to carbonates. Non-carbonate hardness is caused principally by calcium and magnesium sulfates and chlorides, also as previously stated.

There are two principal methods of water softening—the lime or lime-soda process and the cation exchange process. These will be discussed separately and only from the viewpoint of the elementary chemical procedures involved. As a basis for lime-soda softening, certain tests are necessary.

**Determining the Hardness**—A test for total hardness is necessary to measure the amount of calcium and magnesium compounds, which include those causing carbonate as well as non-carbonate hardness. That is, total hardness tests will show the amounts of the compounds causing hardness.

The test for hardness, with the analyses for phenolphthalein and methyl orange alkalinity, permit the computation of many other factors showing information on the characteristics of the water.

Now refer back to the paragraph on alkalinity, hardness and salinity and note how the various chemical impurities affect the water quality. Total hardness must always be one of three things: equal to, more than or less than total alkalinity.

When total hardness and total alkalinity are the same, calcium and magnesium bicarbonates and carbonates produce all of the hardness, which is carbonate hardness. Example: Alkalinity to methyl orange 60; total hardness 60. All hardness is due to calcium and magnesium carbonate and bicarbonates.

When total hardness exceeds total alkalinity, the hardness is made up of the carbonate hardness, which equals the alkalinity, and the non-carbonate hardness which equals the total hardness less the alkalinity. Example: Total hardness 80; total alkalinity 60. Non-carbonate hardness is  $80 - 60 = 20$  ppm and carbonate hardness is 60.

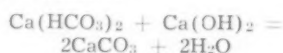
When the total hardness is less than the total alkalinity, there is no non-carbonate hardness, and the difference between the total hardness and alkalinity measures the amount of sodium and potassium

carbonates that are present. Example: Total hardness 60; total alkalinity 80. All of the hardness is carbonate hardness, and there are  $80 - 60 = 20$  ppm sodium and potassium carbonates and bicarbonates.

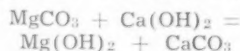
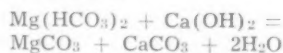
In water softening, these sodium and potassium carbonates and bicarbonates can be neglected, as they do not affect hardness. In analyses, these are stated as negative non-carbonate hardness and are subtracted from the total alkalinity to show total hardness.

**How Chemicals Soften Water**—As already stated, the carbonate hardness is due to the presence of calcium and magnesium bicarbonates and carbonates. The calcium carbonate is soluble only to the extent of 20-30 ppm. In excess of this amount, the calcium carbonates are insoluble and will precipitate and settle out. By changing the bicarbonates to carbonates, carbonate hardness, due to calcium can be reduced to about 30 to 50 ppm.

This can be accomplished by adding lime which combines with the  $\text{CO}_2$  in the bicarbonates and converts them to normal carbonates. The reaction for calcium bicarbonates when hydrated or slaked lime is added is:

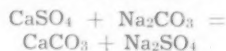


The reaction with magnesium is the same, but since  $\text{MgCO}_3$  is soluble, it is converted to the insoluble  $\text{Mg}(\text{OH})_2$  by the addition of more lime. This addition of an excess of lime produces caustic alkalinity, and when magnesium is present forms magnesium hydroxide, which precipitates in large white flakes. The reaction is:



It therefore takes about twice as much lime to remove a given amount of  $\text{Mg}(\text{HCO}_3)_2$  hardness as it does an equal amount of  $\text{Ca}(\text{HCO}_3)_2$  hardness. In the lime-soda softening process the Ca precipitates out at a pH of 9.4 while the pH must be raised to 10.6 before the Mg will precipitate.

The non-carbonate hardness ( $\text{CaSO}_4$ ) can be removed by adding soda ash,  $\text{Na}_2\text{CO}_3$ , as follows:



When using lime, consideration must be given to its purity, or CaO content. The atomic weight of Ca is

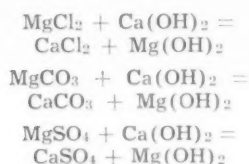
40.08 and of O is 16. The total molecular weight of CaO is therefore 56.08. Hydrated (powdered) lime consists of  $\text{CaO}$  and  $\text{H}_2\text{O}$ , and is therefore  $\text{Ca}(\text{OH})_2$ . The molecular weight is  $40.08 + 2.02 + 32.00 = 74.10$ . On the basis of effective CaO, therefore, hydrated lime is, by weight,  $56.08 \div 74.10 = 75.7$  percent CaO. Note that hydrated lime is powdered  $\text{Ca}(\text{OH})_2$  and is purchased in bag or in bulk. While slaked lime has the same formula,  $\text{Ca}(\text{OH})_2$ , it is a liquid made by adding  $\text{H}_2\text{O}$  to quicklime, CaO. Commercial grade high-calcium quicklime may contain only 88 to 90 percent CaO. High calcium hydrated lime usually contains 68 to 70 percent CaO. These impurities, if present, must be determined and allowed for.

**Softening Computations**—In lime softening computations, analyses are required to show the free  $\text{CO}_2$ , the half-bound  $\text{CO}_2$  the non-carbonate hardness and the total magnesium. Lime must be added to react with the two forms of  $\text{CO}_2$  and the magnesium. Soda-ash is added to react with part of the non-carbonate hardness that must be removed to lower total hardness to a desired level. Half-bound  $\text{CO}_2$  equals 44 percent of the alkalinity, as follows. The atomic weight of  $\text{CaCO}_3$  is 100.09, and of  $\text{CO}_2$  is 44.01, which is 44 percent of the weight of  $\text{CaCO}_3$ .

The amount of lime theoretically required to react with  $\text{CO}_2$  is determined by adding together the free  $\text{CO}_2$  and the half-bound  $\text{CO}_2$ , both expressed in ppm, and multiplying by a factor which is determined as follows: The atomic weight of  $\text{CaCO}_3$ , which is the compound into which it is desired to convert the  $\text{CO}_2$  by the addition of lime, is  $40.08 + 12.01 + 48.00 = 100.09$ , of which the weight of  $\text{CO}_2$  is 44.01, and of CaO is 56.08. For each ppm of  $\text{CO}_2$  present, there will be required  $56.08 \div 44.01 = 1.272$  parts of CaO. Since 1 ppm equals 8.34 pounds per million gallons,  $8.34 \times 1.272 = 10.6$  pounds of pure lime are required for each ppm of  $\text{CO}_2$ , whether free or half-bound, per million gallons of water. These data are for lime with 100 percent CaO and must be corrected for the actual CaO content of the commercial grade of lime being used.

The removal of magnesium is accomplished by adding lime. The analysis should show the total magnesium present as ppm Mg. This magnesium, which is in the form of chlorides, carbonates or sulfates, must be changed by the addition

of lime to magnesium hydroxide,  $\text{Mg}(\text{OH})_2$ . The reactions, simplified, are expressed as follows:



The  $\text{Ca}(\text{OH})_2$  is, of course, either hydrated or slaked lime, but computations are on the basis of  $\text{CaO}$ .

Since the analyses show the magnesium present in any of the above forms, the amount of lime required

is in the ratio of the atomic weights of  $\text{CaO}$  and  $\text{Mg}$ , or 56.08 and 24.32 respectively. For each ppm of  $\text{Mg}$  there will be required  $56.08 \div 24.32 = 2.306$  ppm of lime, or  $2.306 \times 8.34 = 19.23$  pounds per million gallons. If there are 20 ppm of total magnesium,  $20 \times 19.23 = 384.6$  pounds of lime will be required per million gallons.

Soda ash is required to remove non-carbonate hardness, which it does by converting the soluble calcium sulfates and chlorides to insoluble calcium carbonates and soluble, but non-hardness producing, sodium sulfates and chlorides. Since

the non-carbonate hardness is expressed by the analyses as ppm of  $\text{CaCO}_3$ , for each ppm of non-carbonate hardness, there will be required  $46.00 \div 12.01 + 48.00 = 106.01$  (the molecular weight of  $\text{Na}_2\text{CO}_3$ ) divided by 100.09 (the molecular weight of  $\text{CaCO}_3$ ), or  $(106.01 \div 100.09) \times 8.34 = 8.84$  pounds of pure soda ash per million gallons for each ppm of non-carbonate hardness. Soda ash is usually about 99 percent pure.

**Examples of Calculations**—The analyses of a water shows the following: Free  $\text{CO}_2$ , 2 ppm; alkalinity 60 ppm; non-carbonate hardness, 90 ppm; total magnesium, 12 ppm. Determine the amount of chemicals required for treatment.

The first decision to be made is the amount of hardness to be removed. It is not generally desirable to remove all the hardness. In fact it is impossible to do so with the cold lime-soda process. Assume it is possible to remove all but 35 ppm of carbonate hardness with lime and that the finished water is to have a total hardness of 85 ppm. Therefore,  $85 - 35 = 50$  ppm of non-carbonate hardness may be left in the water. Non-carbonate hardness to be removed is  $90 - 50 = 40$  ppm.

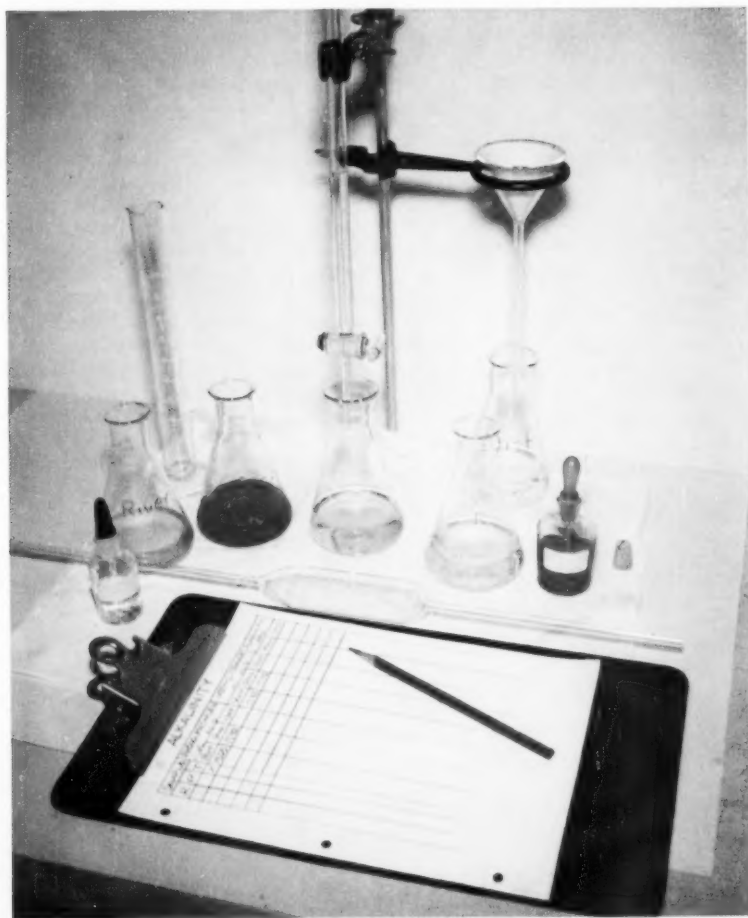
Lime will be used as follows: To neutralize  $\text{CO}_2$ , free and half-bound,  $2 + (60 \times .44) = 28.4$  ppm. Then  $28.4 \times 10.6 = 301$  pounds per million gallons. To react with and remove the magnesium,  $12 \times 19.23 = 231$  pounds per million gallons. Total pure lime required per million gallons =  $301 + 231 = 532$  pounds.

Soda ash required for removal of non-carbonate hardness, amounts to  $40 \times 8.84 = 353.6$  pounds per million gallons.

If alum is used for coagulation, additional soda ash or lime may be required, as shown later.

The above computations are on the basis of 100 percent pure lime,  $\text{CaO}$ , and 100 percent  $\text{Na}_2\text{CO}_3$ . Corrections must be made for lower purities or contents. For instance, if lime is 88 percent pure it will require  $532 \div 0.88 = 605$  pounds of commercial grade per million gallons.

The  $\text{CaCO}_3$  resulting from the addition of lime settles best at pH 9.4 whereas the  $\text{Mg}(\text{OH})_2$  settles best at pH 10.6. For most effective removal of hardness, therefore enough lime may be added to produce the magnesium floc at pH 10.6. After settling,  $\text{CO}_2$  can be added by a recarbonation process to reduce the pH to 9.4 at which point the calcium carbonate settles



Determining the Alkalinity of Water

The alkalinity test is a valuable aid in controlling process variables for several phases of water treatment, such as coagulation, softening and corrosion control. The presence or absence of respective concentrations of hydroxides, carbonates and bicarbonates are determined by this test. Two titration endpoints are involved. The first, using phenolphthalein, contained in the bottle at the left, proceeds from a pink coloration (if hydroxides and carbonates are present) to a colorless endpoint. The second, using methyl orange as an indicator, goes from yellow to pinkish-orange.



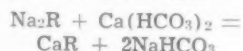
best. In order to deliver water that will not deposit  $\text{CaCO}_3$ , further recarbonation is utilized to reduce the pH to 8.7 or lower, or Calgon, a polyphosphate, may be employed to stabilize the water with respect to calcium carbonate.

The results obtained by these computations are subject, in actual practice, to variations and the theoretical computed dosage may not be exactly that actually needed. It is always desirable to check the calculated amounts of chemicals by means of jar tests, using a liter, a quart or a gallon of water and noting results.

### ***Ion-Exchange Softening***

Until recently most ion-exchange material was called zeolite. There are two general types of ion-exchange materials; those that remove dissolved elements carrying a positive charge such as  $\text{Ca}^{++}$ ,  $\text{Mg}^{++}$  and  $\text{Na}^+$ , which are called cation-exchangers, and those capable of removing negatively charged ions such as  $\text{Cl}^-$  and  $\text{CO}_3^{--}$ , which are called anion-exchangers.

Cation-exchangers are of importance in water softening, while the anion exchangers must also be used for complete demineralization of water for special industrial uses. Cation-exchanger materials are produced from synthetic resins, greensand (zeolites), sulfonated coal and inorganic gels. The softening action is one of replacement or exchange and might be represented by the following formula:



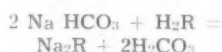
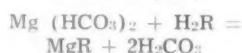
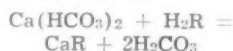
Here we have permitted the symbol R to represent the complex replaceable part of the cation exchange material,  $\text{Na}_2\text{R}$ . Note that the calcium ions have been concentrated and held on the cation-exchange material. They are held, as CaR, in the exchanger while the  $\text{NaHCO}_3$ , which is soluble, passes out in the softened water. A similar reaction occurs for Mg and not only includes the bicarbonates but also the sulfates.

A cation exchanger has the ability to remove from 2,500 to 35,000 grains of hardness per cubic foot of exchange material before it is exhausted and requires regeneration. The exchange capacity varies with the type of material used. The sodium-cation-exchanger is regenerated with NaCl in the following reactions:

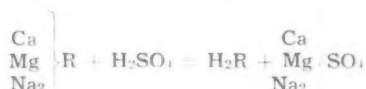


The  $\text{CaCl}_2$  produced is wasted to the sewer in the regeneration cycle. Now the exchanger is ready for softening again.

Some cation-exchangers are operated on the hydrogen, instead of the sodium, cycle and are regenerated with an acid. Typical reactions are as follows:



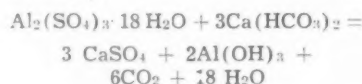
The hydrogen-cation-exchanger may be regenerated with  $\text{H}_2\text{SO}_4$  as illustrated by the following:



The Ca, Mg or  $\text{Na}_2$  sulfates are wasted in the regeneration cycle.

### ***Aluminum Sulfate in Coagulation***

When aluminum sulfate,  $\text{Al}_2(\text{SO}_4)_3$  is used as a coagulant, alkalinity must be available to form the desired floc. When calcium bicarbonate,  $\text{Ca}(\text{HCO}_3)_2$  is used to supply the alkalinity, it combines as follows:



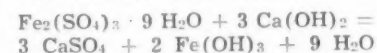
It will be noted that three Ca units are necessary to combine with the three  $(\text{SO}_4)$  units, and that the six  $\text{HCO}_3$  units break down into six  $\text{CO}_2$  and two  $(\text{OH})_3$  units. In the 3  $\text{Ca}(\text{HCO}_3)_2$ , there are six H, six C and eighteen O. In the six  $\text{CO}_2$  units there are six C and twelve O; in the  $(\text{OH})_3$  units there are six O and six H. The 18  $\text{H}_2\text{O}$  water of crystallization molecules are released as 18  $\text{H}_2\text{O}$ . Thus the equation is balanced.

Theoretically, for complete reaction, 7.7 ppm of alkalinity are required for each grain per gallon of aluminum sulfate. This theoretical figure is based on using calcium carbonate for supplying the alkalinity. If three  $\text{CaCO}_3$  are substituted in the above equation for three  $\text{Ca}(\text{HCO}_3)_2$ ,  $\text{CaCO}_3$  requirements are calculated on the basis of the atomic weights.

Al,	26.97 x 2 =	53.94
$\text{SO}_4$ ,	96.06 x 3 =	288.18
$\text{H}_2\text{O}$ ,	18.02 x 18 =	324.36
Total $\text{Al}_2(\text{SO}_4)_3 \cdot 18 \text{H}_2\text{O}$ =		666.48
Ca,	40.08 x 3 =	120.24
C,	12.01 x 3 =	36.03
$\text{O}_3$ ,	48.00 x 3 =	144.00
Total 3 $\text{CaCO}_3$ =		300.27

The relation of 300.27 to 666.48 indicates that 300.27 ÷ 666.48, or 45 percent as much  $\text{CaCO}_3$  will be required as  $\text{Al}_2(\text{SO}_4)_3$ . The equivalent of 1 gpg is 17.1 ppm, and 45 percent of 17.1 ppm is 7.7 ppm. This is the theoretical alkalinity required. Actually the amount may vary from 6 to 10 ppm. When lime,  $\text{CaO}$ , hydrated lime,  $\text{Ca}(\text{OH})_2$ , or soda ash  $\text{Na}_2\text{CO}_3$  is used, computations should be made as above. Also, allowance should be made to permit an excess alkalinity of 20 to 25 ppm in the treated water to prevent corrosion. Step-by-step procedures for determining alkalinity requirements, and computing chemical dosages were published in this magazine in the April 1948 issue under the title "Operation of Water Treatment Plants". These procedures covered (a) preparation of solutions, (b) establishing dosages of coagulants for alkaline waters and for waters deficient in alkalinity, and (c) the prevention of corrosion.

**Iron Salts in Coagulation**—Ferric sulfate has the formula  $\text{Fe}_2(\text{SO}_4)_3 \cdot 9 \text{H}_2\text{O}$ . Alkalinity is required for the coagulation reaction, and if the water or sewage does not contain enough alkalinity, it must be supplied by lime or soda ash. When hydrated lime is added to ferric sulfate the following action occurs:



In practice, the alkalinity of the water should be determined by appropriate tests, and any deficiency supplied by adding lime or soda ash. To determine the amount of lime to be added, proceed as follows with atomic and molecular weights:

$\text{H}_2\text{O}$ ,	18.02 x 9 =	162.18
Fe,	55.85 x 2 =	111.70
$\text{SO}_4$ ,	96.07 x 3 =	288.21
Total $\text{Fe}_2(\text{SO}_4)_3 \cdot 9 \text{H}_2\text{O}$ =		562.09
Ca,	40.08 x 3 =	120.24
$(\text{OH})_2$ ,	34.02 x 3 =	102.06
Total 3 $\text{Ca}(\text{OH})_2$ =		222.30

If there is no alkalinity in the water, 222.3 pounds of hydrated lime will be required for each 562.09 pounds of ferric sulfate with the formula  $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ . If the amount of ferric sulfate applied is



1 gpg, or 142.9 pounds per million gallons, the amount of hydrated lime required will be  $222.3 \times (142.9 \div 562.09) = 56.5$  pounds of 100 percent hydrated lime. If the lime is 95 percent pure, about 60 pounds will be required.

It is perhaps more often the case that some alkalinity is present in the water, but not enough for the reaction to take place. Assuming that there are 5 ppm of natural alkalinity as  $\text{CaCO}_3$  in the water, the reaction with ferric sulfate will be incomplete.

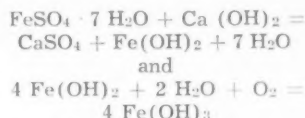
For reaction, the ferric sulfate will require  $3 \times (40.08 + 12.01 + 48.00) = 300.27$  pounds of calcium carbonate for each 562.09 pounds of ferric sulfate. For a dosage of 1 gpg, there will be required  $300.27 (142.9 \div 562.09) = 76.2$  pounds per million gallons. If there are 5 ppm of natural alkalinity available in the water, this amounts to  $5 \times 8.34 = 41.7$  pounds, and only  $76.2 - 41.7 = 34.5$  pounds per million gallons of alkalinity must be added. The relation, by molecular weights, between calcium carbonate and hydrated lime is 100.09 to 74.01, and there will be required  $34.5 \div 0.74 = 46.6$  pounds of hydrated lime per million gallons. In practice, as already stated, some excess alkalinity is desirable. Other factors such as mixing, temperature, etc., affect the reaction and computations cannot be made as closely as the theoretical problem just solved. Probably a residual alkalinity of 20 to 25 ppm would be desirable and the dosage of lime would be increased accordingly.

**Ferric chloride**,  $\text{FeCl}_3$ , is also used for coagulation. When hydrated lime is added to supply alkalinity,  $2 \text{ FeCl}_3 + 3 \text{ Ca(OH)}_2$ , there are produced ferric hydroxide and calcium chloride,  $2 \text{ Fe(OH)}_3 + 3 \text{ CaCl}_2$ . If calcium bicarbonate is present, the reaction is the same, except that  $\text{CO}_2$  is also produced.

The molecular weights of the iron and of the hydrated lime are, remembering that ferric chloride contains 6 atoms of water of crystallization, in the relation of 540.70 to 222.30. Therefore, 222.3 pounds of hydrated lime will be required to react with 540.70 pounds of ferric chloride, and the amount of lime required can easily be computed for any dosage of ferric chloride. In computing the requirements for natural alkalinity, which is based on  $\text{CaCO}_3$ , the same procedure as for ferric sulfate is employed.

**Ferrous sulfate**,  $\text{FeSO}_4 \cdot 7 \text{ H}_2\text{O}$ , commonly called copperas, is used

for coagulation purposes and it too requires that alkalinity be present naturally or that it be adjusted. If lime is added first and then the copperas the reaction is as follows:



In this case the ferrous hydroxide is immediately oxidized to the flocculent-ferric state in the presence of water and oxygen. The molecular weights of  $\text{FeSO}_4 \cdot 7 \text{ H}_2\text{O}$  and  $\text{Ca(OH)}_2$  are 278.06 and 74.10 respectively. It therefore requires 1.0 pound of hydrated lime for each 3.75 pounds of coagulant.

### Removing Iron and Manganese

Iron and manganese are usually closely associated in water supplies and if one is present, the other is quite likely to be also. The U. S. Public Health Service limits the iron-plus-manganese to not over 0.3 ppm for an acceptable water. Iron is usually present as either ferrous bicarbonate,  $\text{Fe(HCO}_3)_2$ , which is soluble or as ferrous hydroxide,  $\text{Fe(OH)}_2$ . If oxygen is added to either of these, rust or ferric hydroxide,  $\text{Fe(OH)}_3$ , is formed which is insoluble. Therefore these iron compounds can be removed by oxidation or aeration, since the  $\text{Fe(OH)}_3$  forming in the water will settle out.

Manganese is more difficult than iron to remove. Manganese compounds, usually found in water, are manganese hydroxide,  $\text{Mn(OH)}_2$ , which is insoluble, or manganese dioxide,  $\text{MnO}_2$ . The reactions are not the same as with iron, and if much manganese is associated with the iron, it may interfere with iron removal. Manganese can be removed by breakpoint chlorination at pH values of 9.4 and above.

Instead of removing the iron and manganese from the water, they may be stabilized so that they will not precipitate in the distribution system and cause complaints of red or black water. Several commercial compounds, such as calgon, are available for this purpose. This is called threshold treatment. To be successful, a definite ratio of the chemical to the iron or manganese must be employed, and the chemical must be introduced before the water is exposed to air or is treated with chlorine. Either air or chlorine oxidizes the iron or manganese, forming insoluble compounds which settle.

Iron and manganese are removed incidental to lime-soda softening. Aeration followed by settling, or filtration is successfully used. Cation-exchangers remove limited amounts of iron but are frequently quite unsatisfactory for high iron concentrations.

### Scale and Corrosion Prevention

Corrosion is due to the solution of exposed metal by water. Its rate is inversely proportional to the alkalinity and the pH and directly proportional to the content of dissolved oxygen, carbon dioxide, temperature and time of contact. One method of preventing corrosion is to adjust the pH value, the  $\text{CO}_2$  content and the alkalinity so as to deposit and maintain a thin coating of calcium carbonate on the interior of the piping system.

The first step in corrosion control is to determine the  $\text{CO}_2$  content and the alkalinity to methyl orange. Consult "Standard Methods for the Examination of Water, Sewage and Industrial Wastes". Assuming a water with a  $\text{CO}_2$  content of 10 ppm and a methyl orange alkalinity of 80 ppm, the general procedure given for softening is followed: The free  $\text{CO}_2$  is 44 percent of the alkalinity, or 44 percent of 80 ppm = 35.2 ppm. Total  $\text{CO}_2$  to be neutralized is  $35.2 + 10 = 45.2$  ppm. The molecular weight of  $\text{CaCO}_3$ , which is the compound that will be formed when  $\text{CaO}$  is added to  $\text{CO}_2$ , is 100.09, of which the weight of  $\text{CO}_2$  is 44.01 and of  $\text{CaO}$  is 56.08. For each ppm of  $\text{CO}_2$ , there will be required  $56.08 \div 44.01 = 1.272$  ppm of  $\text{CaO}$ . Since 1 ppm equals 8.34 pounds per million gallons, there will be required, for each ppm of  $\text{CO}_2$ ,  $8.34 \times 1.272 = 10.6$  pounds of pure lime per million gallons. For the 45.2 ppm  $\text{CO}_2$ , computed above, there will be required  $45.2 \times 10.6 = 479.1$  pounds of lime per MG. If phenolphthalein alkalinity is also present, compute bicarbonate alkalinity as indicated under alkalinity.

By means of the jar test (see PUBLIC WORKS, April, 1948), the amount of lime necessary to prevent corrosion can be determined. The April, 1949 issue also carries a good discussion of corrosion prevention methods.

### Disinfection

Water may be disinfected, not sterilized, by the addition of a number of chemicals which include chlorine, bromine, potassium permanganate, ozone, silver and iodine. In addition to the disinfecting

chemicals there are a number of auxiliary chemicals which are used to aid in the disinfecting process such as sodium chlorite, in the production of chlorine dioxide, and ammonia, in the production of chloramines. When superchlorination is practiced, sulfur dioxide or sodium thiosulfate are used as de-chlorinating agents.

Chlorine is by far the most commonly used, mainly because of its low cost. In fact chlorination and disinfection, to most waterworks men, are synonymous. The amount of chlorine that is needed to disinfect a water varies a great deal from one supply to another. It is always necessary to add more than will register in a chlorine residual test, as the chlorine enters into chemical reactions with water impurities and does not register as chlorine residual. The place of application of chlorine in the treatment process also influences the dosage. If pre-chlorination is practiced it will take more than if only post chlorination is practiced. If a common residual of 0.10 to 0.20 ppm  $\text{Cl}_2$  is reached it will be necessary to apply as much as 1.0 ppm. This feed rate varies tremendously with various supplies and can be ascertained only by experience.

It may be helpful to study the following chart which explains how chlorine residuals occur in relation to the amount of chlorine applied. It is to be noted that the residual may be in the form of combined chlorine or chloramines, a mixture

ppm  $\text{Cl}_2$  to be effective in disinfecting most sewage plant effluents.

### Chemistry in Sewage Treatment

The chemistry of sewage treatment is, in most respects, identical to the chemistry of water treatment. The principles are the same. In sewage treatment, chemicals are used to coagulate the colloidal solids in primary treatment, to condition sludge, to adjust pH in sludge digestion processes and in disinfecting plant effluent. Disinfection and coagulation will not be discussed again.

#### Adjusting pH In Sludge Digestion

—Lime is frequently added to a sludge digester to raise the pH to a value near neutral. It is desirable for sludge digestion to take place slightly above a pH of 7 but for a number of reasons operators find the pH will drop as low as 4.5. Below a pH of 4.0 effective digestion probably ceases.

When it is found that liming a digester gives satisfactory results, the addition needs to be carried out carefully to make certain that lime is well mixed through the digester contents. It should not form a slug of high pH material that doesn't mix in the digester as this condition will tend to discourage proper digestion. Frequent checking of the pH of the well mixed lime and sludge digester contents will indicate the time when liming may be discontinued.

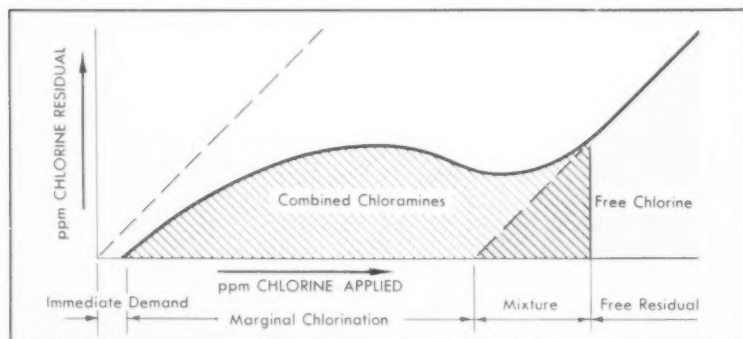
**Sludge Conditioning With Chemicals**—Sewage sludge is conditioned for a number of purposes and by a

The amount of these chemicals, on a pure basis, is computed as a percentage of the dry sludge solids and varies considerably, depending upon the preparation or treatment of the sludge prior to filtration. It has been well established that the liquid portion of the sludge must be coagulated before the flocculating agent is effective in its action with the solids content of the sludge. This is why lime is added first to react with the alkalinity or bicarbonates of the sludge. Then the ferric chloride can flocculate the sludge solids and the sludge is ready for filtration. The amount of the chemicals can be reduced considerably by elutriation, which is the simple process of washing out or reduction of alkalinity of the liquid portion of the sludge. The amount of chemicals, needed to react with the alkalinity, follows regular chemical laws but only experience has indicated how much chemical is needed to coagulate the solids portion of the sludge.

Example: 2500 gallons of sludge with 4 percent solids is coagulated with lime and ferric chloride. In addition to lime, it takes 9.1 gallons of ferric chloride solution, at 11.5 pounds per gallon, having a strength of 40 percent  $\text{FeCl}_3$ , to react with the sludge. Compute the percentage feed of the  $\text{FeCl}_3$  coagulant. Solution: Assume the sludge weighs 8.4 pounds per gallon. Then  $2500 \times 8.4 \times 0.04 = 840$  pounds of dry solids are in the sludge. Also  $9.1 \times 11.5 \times 0.40 = 41.8$  pounds of pure  $\text{FeCl}_3$  are applied, and  $(41.8 \div 840) \times 100 = 5$  percent  $\text{FeCl}_3$  is the rate of application. This is the ratio of pure  $\text{FeCl}_3$  to pounds of dry sludge solids, expressed in percent.

### Expressing Chemical Results

In much of the work covered by this text, the weights or amounts, of the various substances are given in parts per million, which for the purpose of the text have been abbreviated to ppm. Some of these weights or amounts are very small. A standard has been adopted for reporting results, as follows: Except for certain nitrogen compounds, two decimal places are used for ppm between 0.1 and 1.0, as 0.32; for values between 1 and 10, one decimal place is used, as 4.1; between 10 and 100, the nearest whole number is used, as 29; and over 100 only two significant numbers are used, as 180, not 183. When results are tabulated, zeros should not be added to provide the same number of digits beyond the decimal place in each.



● CHLORINE residuals may be chloramines, free chlorine or a mixture of the two.

of combined and free chlorine, and solely free chlorine. When the chlorine residual is all free chlorine it is referred to as "breakpoint chlorination".

Chlorine is applied to sewage plant effluents to protect the health of our communities by killing the pathogenic organisms in the treated sewage. It requires from 10 to 20

number of processes but the most commonly used process, involving chemicals and chemistry, is the preparation of sludge for dewatering on vacuum filters. Ferric chloride or ferric chloride and lime are most frequently used to prepare the sludge for more efficient filtration. Chlorinated copperas, ferric sulfate and alum are also used.



**FELIX RAMSEY**  
 Superintendent of Highways  
 Wyoming County  
 Warsaw, New York

**W**YOMING COUNTY, with a population of about 30,000 has a short growing season and severe winters, but the farmers seem to be as well off and concerned less with government subsidies and handouts than in any of the areas that nature has favored with a more temperate climate. There are many reasons for this but there is no doubt but that good roads have a great deal to do with it.

There are 1088 miles of road in Wyoming County and of these about 40 percent are hard surfaced high type roads. School bus routes traverse the entire county reaching even the most remote farms, yet it is rare for any of the schools to be closed for more than a few days a season because of weather conditions. The last time I can recall that the main roads were blocked for as much as three days was in March 1947. Many of the snow drifts at that time reached depths of over 20 feet. Practically all of the roads were open within a week and, in fact, the County even found time to open the main line of one of the railroads.

To provide such service requires a first class organization with first class modern equipment. It has been our good fortune to have a Board of Supervisors in Wyoming County with the foresight to know that only long range planning and a sound business policy can develop an efficient department. We have never lacked for suitable modern equipment and have never hesitated to try new procedures when it was reasonably obvious that much could be gained from them.

All of the work in the County Highway Department is done by our own forces rather than on a contract basis. This allows a flexibility in our operations whereby we can immediately take advantage of new developments. We pioneered in the use of arc-welding, particularly in the building and repair of bridges. We also built the first Freyssinet type prestressed concrete bridge in the United States and have even developed a precast concrete block bridge abutment which has proven very efficient.

Some 25 years ago it was general practice for contractors and highway departments to lay off all of the men in the fall and hire them again in the spring. With modern equipment and specialized work it has become an absolute necessity for such organizations to provide year around employment. We now haul and stockpile stone for the next season's work besides overhauling

equipment. Also we make all of our own concrete culvert pipe up to 4 feet in diameter and we cast bridge beams and abutment blocks for prestressed concrete bridges. That together with what necessary snow plowing and sanding of roads we must do, tends to make winter our busiest season.

Our system of County Highways consists of 230 miles of secondary improved roads on which the traffic count varies from about 30 to 700 vehicles per day. Over a hundred miles of these roads have a heavy bituminous surface at least twenty feet wide with most deflections limited to curves of 4 to 6 degrees and grades limited to 10 percent. Such alinement and grade imposes quite a problem since the entire terrain is rolling and hilly, varying in elevation from 600 to 2300 feet above sea level. We are rebuilding and resurfacing the older roads at the rate of about 16 miles a year.



● PRESTRESSED concrete bridge built by Wyoming County in 1955. Floor consists of six precast, prestressed beams, each two feet wide. Clear span is forty feet.



Since our budget is very limited, it is vital that we build the type of road which will require a minimum of maintenance. We try to avoid any frills which might cost a lot but add little to the utility of the road. The roads we have been building have shoulders at least 10 feet wide with grades kept high and backslopes streamlined to avoid snow traps. The construction cost of such roads has been from \$6,000 to \$12,000 per mile depending on conditions. Added to this is the cost of surfacing which in the past few years has averaged \$8,200 per mile.

It is very essential to have a well compacted base of at least a foot of good gravel or the equivalent in this type of surfacing. Where we have built or rebuilt the road and left fresh gravel on the surface, we treat it with about half a gallon per square yard of rather light oil or tar to bind the gravel and hold down the dust. We usually allow this to settle over the winter and then repair any weak places which may develop by spring. When the weather has finally turned warm in the late spring, we put stone on the road.

The stone we use is a crushed limestone or dolomite of No. 2 size (passing a 1" screen and retained on a ½" screen). It is applied to the road through a box which leaves a layer ten feet wide and about five inches deep. This stone is then treated with an application of tar-asphalt emulsion at the rate of 0.9 gallon per square yard which is about 2 gallons to the lineal foot of road. The stone and emulsion are then mixed by scraping it in 3 passes with a grader blade, to form a windrow on the side of the road. It is then moved back to the other side of the road with 3 more passes of the grader. Then it is moved back to the starting side again with 3

more passes. It is very important that the grader blade scrapes all the way down to the bare road on each of the passes or the stone will not be properly coated.

Another three passes are made, but this time the mix is spread over the road so that it is about 1 inch deep on the starting side and 5 ins. deep on the other side. A final 3 passes are made to level the mixture over the entire road, making 15 trips with the grader in all.

This mix is then allowed to set up over night with the traffic kept off, and rolled in the morning using a tandem 10-ton wet roller. After one rolling, No. 1 stone (passing a ½" screen and retained on a ¼" screen) is spread over the road at the rate of about 40 to 50 tons to the mile, to chink the voids. The road is then rolled again until noon. The next morning the road is again rolled to smooth out any ruts which may have developed from traffic during the afternoon and night.

Unless we are in a prolonged dry spell we check with the Buffalo Weather Bureau each morning before starting work. A sudden shower will not spoil the work if we have a reasonable amount of mixing done. Some of the emulsion will wash off but then we increase the amount of seal coat later.

To get a thorough coating on the stone, it must not be wet when the operation starts. A little dampness will not hurt but if it is soaked from rain it must be turned over several times with the grader to dry it out before the emulsion is applied.

Since the season for this work is short we work long days and average ¾ mile a day. In an 8-hour day we could probably do about a half of a mile a day.

From 2 to 5 days after mixing, the road is treated with a seal coat of

0.5 gallon per square yard of a slightly heavier grade of the same tar-asphalt emulsion. This coat is immediately covered with a layer of No. 1 stone at the rate of about 80 to 100 tons per mile, and thoroughly rolled.

A month or so later a second seal coat is applied using the same amounts and types of emulsion and stone. This is then rolled with the heaviest roller available—preferably 12 to 15 tons—until the road is thoroughly shaped and smooth.

This results in a well compacted pavement about 2 to 2½ inches deep with a non-skid surface. If properly done it provides a very smooth road capable of withstanding heavy year around traffic. We usually wait a month or so or until cold weather sets in to trim the shoulders to the new pavement. It will not attain its maximum hardness until the following year.

It is not our intention in preparing these pavements to try to make a substitute for premix material, but rather to aim for a modification of penetration type macadam. We have penetration type macadam roads in this county over 40 years old which have outlasted any other type of construction with the possible exception of brick. The one fault of a brick pavement was that it was difficult to get it smooth in the first place. We also have mixed-in-place roads that are 25 years old and still are in excellent condition, requiring surface treatment only every 5 or 6 years.

The one discouraging thing about building such roads is that as soon as they are built, all the people living along the road immediately want quantities of signs erected limiting traffic to the very same speed it was effectively held to by the roughness of the original road.



● MULTIPLATE corrugated culvert replaces an old bridge.



● SPREADING stone for resurfacing job on a County road.



## NEW SEWAGE TREATMENT PLANT

# *is the Result of* ENLIGHTENED PUBLIC SENTIMENT

COURT orders were necessary in 1950 before the City of Raleigh, N. C., would entertain the idea of constructing primary sewage treatment facilities. But in 1956 the rapidly growing city, no longer willing to settle for the original 8-mgd primary treatment plant, which would accomplish about a 40 percent reduction in pollution load, is fast completing a 12-mgd system providing primary and secondary treatment plus chlorination. Reduction is designed to be upwards of 90 percent.

What happened between times was the development of an enlightened public sentiment for municipal improvements that would help attract industry to what was earlier an almost industry-less state capital. The citizens of Raleigh authorized a bond issue of some \$1,500,000 in 1951 for the court-ordered primary treatment plant, then proceeded to double the sum in 1954 so the new plant might be as up-to-date as the industry Raleigh is courting.

Action of Wake County Superior Court in 1950 in ordering the City of Raleigh to install sewage treatment facilities to reduce pollution of the Neuse River—the raw water source for the plaintiff Town of Smithfield, N. C.—brought the city fathers up short. Within a relatively short time Raleigh had set up a City Planning Board with a full-time director.

One of the first actions of this Board was to establish minimum standards for acceptance of industrial wastes into the city sewerage system. Shortly thereafter, the Westinghouse Corp. came to Raleigh with a multi-million dollar new plant for the manufacture of watt-hour meters. The process called for considerable electro-plating and discharge of acid wastes.

The fact is that the new Westinghouse plant in Raleigh is equipped for pretreatment of industrial wastes, and is so largely because an enlightened city administration had set up such standards beforehand. Raleigh, with almost no industry to begin with, is lucky

**J. L. MORRISON**

Associate Professor

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enough to begin its program of sewage treatment with no initial industrial waste problem.

### **The New Plant**

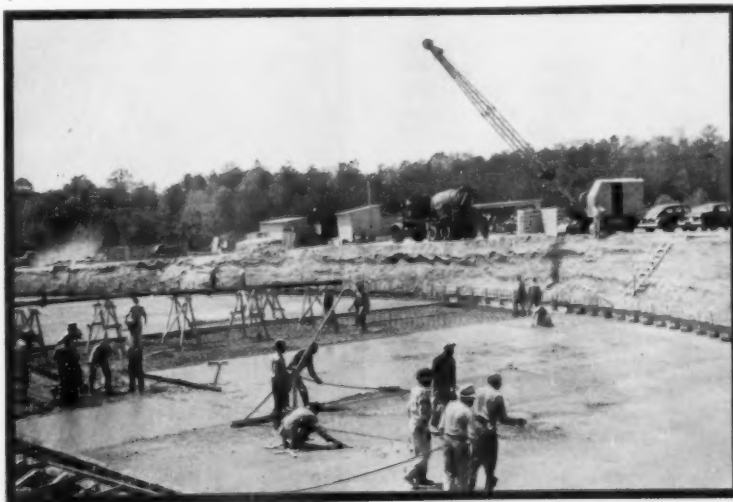
The new system, due for completion this fall, will cost just over \$3,000,000, including the plant proper, two trunk sewers and a pump station. The plant itself will cost \$2,100,000. It was designed by the Raleigh consulting firm of William C. Olsen and Associates. Lee Construction of Charlotte is the general contractor. Other prime contractors, all of Raleigh, are Page Electrical Service; Rural Plumbing and Heating; and Bullock & Proctor.

The new system includes two 42-inch trunk sewers along Walnut and Crabtree Creeks, two streams flowing parallel and eastward from Raleigh and divided by a central ridge. A pump station on the Crabtree Creek side of the ridge will lift, by means of a force main, sewage into the disposal plant on the Walnut Creek side.

Trunk sewers are some 20,000 ft. in length for Walnut Creek and 16,000 ft. for Crabtree. The 42-inch size was selected to meet better future needs of the overall system. The disposal plant can easily be en-



● CONSTRUCTION for the secondary clarifier starts with the influent pipe.



● POURING concrete floor for a trickling filter. Crane handles concrete bucket.

larged to handle 16 mgd; and even further enlargement can come by replacing the pump station with a second disposal plant, one for each of the two creeks in that case. It is felt, however, that 42-inch trunk sewers will continue amply large for any conceivable expansion.

The willingness of Raleigh citizens to approve the enabling bond issue referendum ties in interestingly with City Manager W. H. Carper's experience with such referendums.

"I know this theory of mine doesn't hold true in every case," he smiles, "but it has certainly worked out for me. Item Number 1 on the referendum program invariably gets a larger vote than Number 2, and so on down the line until, if the list is a long one, the last few items can wind up defeated.

"In our 1951 referendum," he adds, "the construction of primary sewage disposal facilities was Project Number 1 in a list of five. Project Number 1 passed easily, but Number 5—a community recreation program—was very nearly defeated, with each successive project receiving fewer and fewer 'yes' votes.

"Again in 1954, the sewage treatment plant was Number 1 on a list of three, and this time Number 3 actually went down to defeat. The sewage treatment project passed easily, and Number 2—providing for a new water-impounding lake—passed less easily, whereas Number 3—providing for a new and badly needed city hall—was defeated by 87 votes."

### Head the List to Get Approval

Mr. Carper's interesting theory is that voters are apt to be less generous as they proceed down a bond issue list, and therefore it is sound practice to head the list with the least popular project to take advantage of this initial generosity.

Raleigh's Walnut Creek sewage treatment plant covers some 35 acres southeast of Raleigh. Major items of equipment are as follows:

Electric-driven dry well pumps, all by Fairbanks-Morse, include four 1-mgd and two 10-mgd, equipped with float control and of variable speeds. Bar screen is by Chain Belt Co.; grit chamber equipment by Dorr-Oliver; and meters, transmitting and recording devices by Builders-Providence.

There are three circular primary sedimentation basins, each 95 ft. in diameter, equipped with Dorr-Oliver sludge collecting mechanisms. The three trickling filters are each 190 ft. in diameter with 5 ft. depth of



● CONCRETE for a clarifier wall is conveyed by the Pumpcrete machine at left.

stone. Distributing equipment was furnished by Dorr-Oliver and underdrains by Pomona Terra Cotta Co. The three secondary sedimentation basins are of the same dimensions as the primaries and similarly equipped.

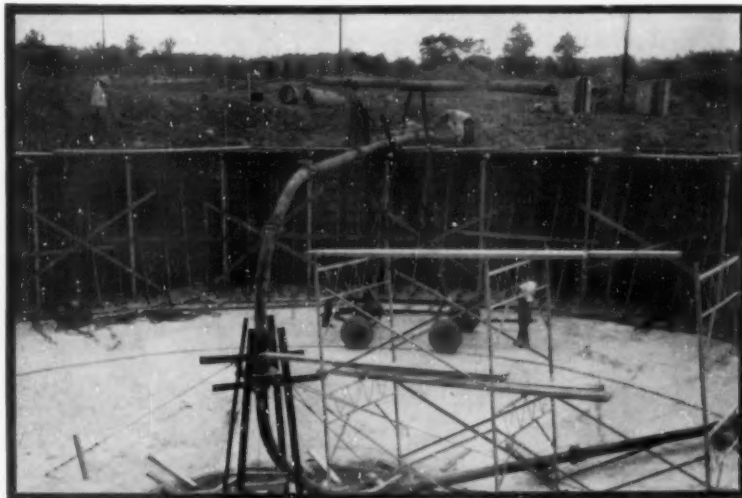
Two sets of recirculating pumps, each set consisting of four pumps with a capacity of 8 mgd, recirculate the settled sewage from the secondary basins to the trickling filters. These pumps are Fairbanks-Morse as are the two sets of secondary sludge recirculating pumps, each with a capacity of 1 mgd.

The system's chlorine contact tank is of concrete with a detention period of 30 minutes at the design flow, with the chlorine applied automatically in accordance with the rate at which sewage is discharging at the time.

There are three 85-ft.-diameter digestion tanks with floating covers, equipped with gas collectors and external exchanger, all products of Pacific Flush Tank Co. Depth of each tank is 21.75 ft., total capacity 370,260 cu. ft. The operating building is provided with space for dual generating facilities using gas, if that should prove economical in the future.

The 4½ acres of sludge drying beds provide an area of 1½ sq. ft. per capita for the design population of 130,000.

All investigating, gauging and design data for this sewage treatment plant were cleared with the State Stream Sanitation Committee, whose executive secretary, E. C. Hubbard, worked closely with the Olsen firm's Carl Mengel in bringing the project to realization.



● VIEW from interior of clarifier shows the hose used for concrete placement.

# THE "AIR AGE" COMES



## to SEEDING and FERTILIZING

THE VALUE of using turf on roadsides, not only on main highways but along secondary highways as well, is now widely recognized. Starting twenty-five or thirty years ago as a "dress-up" operation along some main highways, the practical aspects of preventing erosion of soil and siltation of culverts and open drainage ways by having a good cover of grass on all exposed soils has become recognized as a proper and integral part of highway construction almost everywhere.

Prior to the last decade the complications of seeding operations and the cost of materials had been considered a nuisance to many contractors and engineers. About ten years ago, however, the landscape engineers in New York State began testing and permitting the use of hydraulic seeding equipment and new and simplified seeding procedures. Topsoil was frequently omitted. Seedbed preparations were reduced to a minimum. Lime, fertilizer, and seed were applied simultaneously by being pumped from a tank of water. Seeding was permitted almost any day of the year, especially if a mulch were used. These and other reasons have brought down the cost of seeding, aside from the cost of topsoil, to one-third and even one-sixth of its former levels, in spite of generally rising costs of both labor and materials. The turf resulting from these streamlined methods is considered adequate.

A hydraulic seeder of this type comprises a tank, paddles or a jet to agitate the slurry, a small gas engine to drive a centrifugal pump and some fire hose. If necessary, it can be put together in most maintenance shops. A rig with a 1000-gallon tank will fertilize and seed  $1\frac{1}{2}$  to 2 acres in a half an hour, with one operator and a driver. Much time is consumed in the hauling of large volumes of water so the use of air to distribute the seed

and fertilizer has intriguing possibilities.

The use of a sand blast machine and compressed air has lately come into rather common usage for distributing granulated fertilizer in maintenance fertilizing operations and is currently being used by a number of highway departments. Considerable savings in time are made; For example, one job of 30 acres was done in three hours using granulated 33  $\frac{1}{3}$  percent ammon-

ium nitrate at about 120 pounds per acre. This is twice as fast as the hydraulic method, even where water is readily available.

### Seed Pelleting

Such fertilizing is becoming increasingly important because more and more roadsides are being seeded on subsoil. Many subsoils, in fact all soils which are low in their silt and clay content, are unable to continue to support a good growth of grass unless nitrogen is replaced from time to time. It may be required even as often as twice in a given year until a good turf is established. Maintenance fertilizing must be done and low cost methods are current interests.

The development in recent years of seed pelleting processes that do not adversely affect germination has suggested that air used as a propellant might effect savings in the seeding operation as well as in the fertilizing operation. "Fertilizing &

E. W. MULLER, JR.

Landscape Architect

New York State

Department of Public Works



● SPEEDY application of pelleted seed and granular fertilizer by means of compressed air. A close-up of the sand-blast gun used for this work is shown above.



Seeding with Compressed Air", publication #356 of the Highway Research Board, National Academy of Sciences — National Research Council, covers work done by the Landscape Bureau of the New York State Department of Public Works. It shows that pelleted grass seed and granulated fertilizer have been applied successfully to highway slopes for distances of over 100 feet with a standard air compressor.

Pelleting of seed is the process of coating each individual grass seed with inert material. This increases its size and weight several times, thereby lending itself to distribution by air pressure. The covering may or may not include some fertilizer and/or fungicide. The coating disintegrates readily in the presence of moisture, and protects and helps keep the seed viable if a period of drought and heat precedes favorable germinating conditions.

Although granulated fertilizers cost about the same as ordinary commercial kinds, the pelleting of seed is quite expensive. The cost of pelleted seed could undoubtedly be reduced by mass production, but there is a need for further development of equipment that will be capable of handling larger volumes of material.

#### **New Seeding Equipment Being Developed**

Lately this development has taken two separate forms. One company is currently working on equipment that uses compressed air. Other tests are in progress using air blowers. The latter is subdivided into the modified ensilage blower type currently used to blow mulch, and the mist blower. It is possible that adaptations of mist blowers may eliminate the need for pelleting the seed.

Recent developments indicate that the compressor type equipment gives better distance deliveries, but both air blower types give faster volume deliveries.

The air blower types have multiple uses; the modified ensilage blowers could, of course, continue to be used for blowing hay or straw as a mulch for seeding operations while the mist blowers would continue to function in their original capacity for spraying insecticides and perhaps even be adapted to distributing a mulch.

These principles of using water and air as propellants have proven satisfactory when adapting such equipment as orchard spray rigs and sand blast machines. As competition grows keen, we should see more efficient equipment in every day use, thus speeding up operations and decreasing both construction and maintenance costs.

# The YIELD SIGN

## for RURAL HIGHWAYS

**H. H. HARRISON**

Engineer of Traffic  
Illinois Division of Highways

CONSIDERABLE PUBLIC interest is bound to be generated by the triangular Yield Right-of-Way signs that have lately been placed in divided highways in Illinois. The message of the sign is so clear that very little confusion is expected in its observance by motorists. However, few persons are aware of the reasons for the adoption of the sign.

One of the most compelling reasons for instituting this sign has been the recent large increase in the mileage of divided highways in Illinois, now over 300 miles. Before adoption of the Yield sign, it was necessary to make two stops—one for each roadway—when crossing a divided highway. Under the present arrangement, a motorist crossing a divided highway must stop for the stop sign before crossing. When the way is clear, he proceeds to the median where he was formerly confronted with another stop sign, but now faces a Yield sign, and may proceed without stopping if the way is clear. This use of the Yield sign is an un-

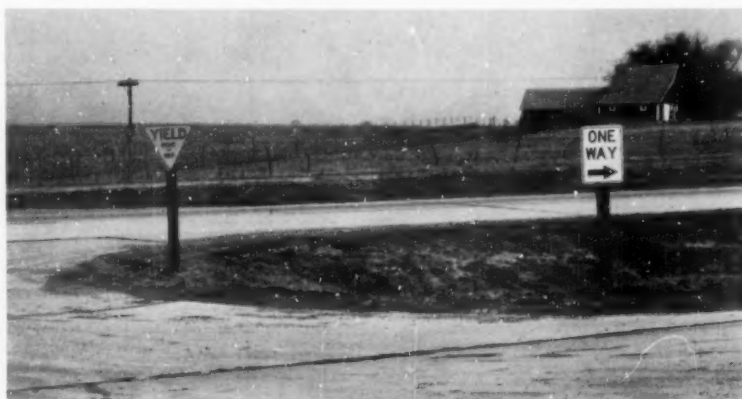
usual example of a regulatory sign allowing a motorist more, rather than less, freedom.

#### **Locations for Yield Signs**

During the early stages of the use of this sign the specifications as to where it might be placed were rather narrow. They are to be located at all public highway cross-overs or median openings facing traffic entering the second roadway of a divided highway. This speci-

cation applies where the median is more than 15 feet but less than 50 feet wide. When the median is more than 50 feet in width Stop signs are to be used as in the past.

Yield signs are also specified at a few scattered locations where their use is appropriate. Examples of these are on ramps of highway interchanges and at a few two-lane highway intersections where the design is such that the yield is preferable to merging control.



● TYPICAL installation of "Yield" sign at intersection of a divided highway.

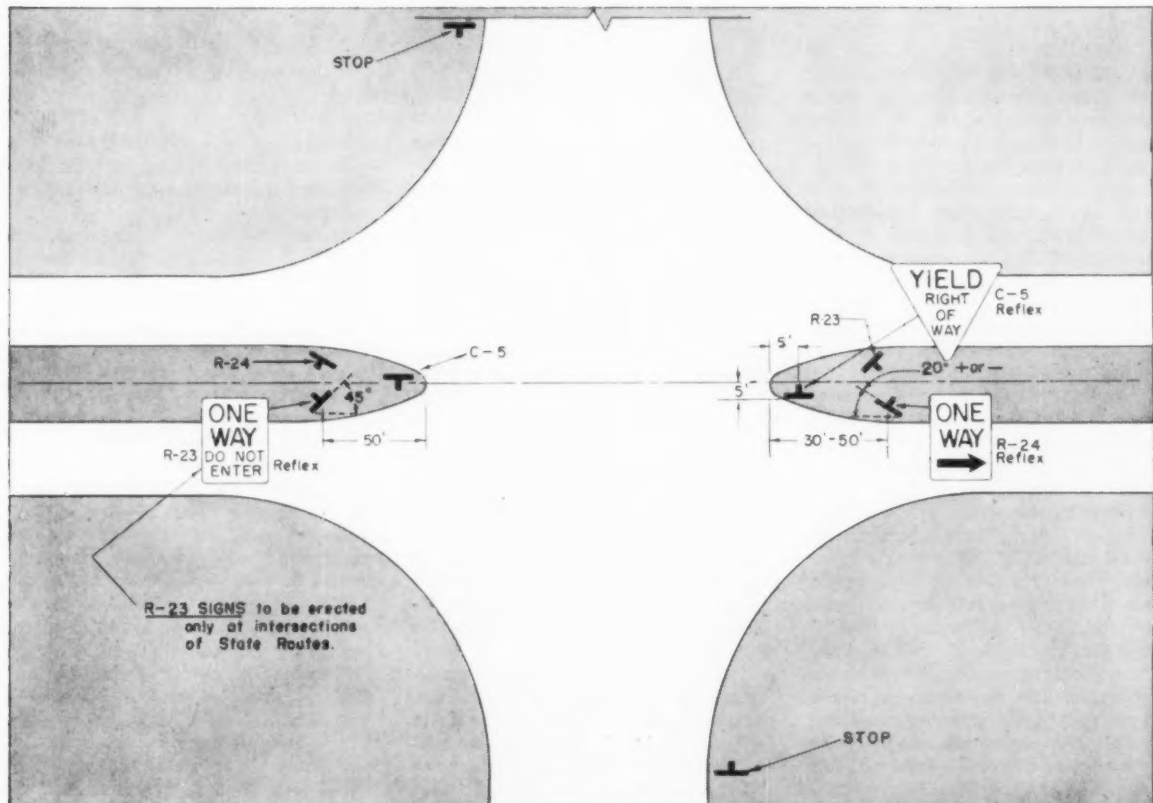


Some intersections in the past have been marked with a "Merging Traffic" sign in combination with a rectangular "Yield Right-of-Way" sign. This practice has been discontinued. At these intersections where the convergence of the roadways is such as to facilitate merging of traffic, the "Merging Traffic" signs will be retained and the rectangular yield signs removed. Drivers on both roadways are required to ad-

will be specified in the official Illinois Sign Manual in the next revision which may be published within a year. Should this eventuate, there will no doubt be some Yield signs erected where there were no signs of any kind before. Such a location would be at an intersection which has a light traffic volume but where heavier amounts of traffic flow at intervals on one of the streets. Used in this way, the

ence but in general, where it has been properly used, it has been found beneficial.

If drivers in Illinois have difficulty at Yield signs it will probably be after they have reduced to 20 mph and yielded to other drivers. Their main problem may be to judge the time at which a safe interval in traffic permits them to proceed. This has proved increasingly difficult for motorists who



● STANDARD method of sign placement used at intersections of divided highways.

just their speed and lateral position so as to avoid collisions.

At certain other locations the old "Merging Traffic" signs may simply be replaced by the new triangular Yield signs. Yield signs will be used at locations wherever the separate turning roadway approaches the divided major highway at a flat angle but where the constructed lanes are inadequate for a merging maneuver.

It is well to note that the law requires drivers when passing a Yield sign to slow down to 20 mph or less, to yield to vehicles on the major roadway, and to accept responsibility in case of mishap. Failure of drivers to interpret and observe this sign properly, will cause its use to be narrowly restricted.

It is anticipated that uses of the Yield sign for counties and cities

Yield sign would place a new restriction upon the motorist.

#### Observance of the Yield Sign

The use of the Yield sign should be regarded more in the light of a trial than as something permanently established for it cannot be predicted how the Illinois motorist will react to it. Whenever any innovation is made relating to motor traffic there is nearly always a suspicion that it might be followed by the occurrence of more, rather than fewer, accidents. However, the Yield sign in Illinois conforms to standards of color, size, shape, and message which have been adopted nationally. Use of the sign in other states has produced a varied experi-

have stopped in obedience to stop signs. This suggests that a motorist who cannot judge a safe interval in traffic after stopping, may not do as well when traveling up to 20 mph at a Yield sign. On the other hand, the momentum of a vehicle at 20 mph may be sufficient to carry a driver safely across whereas a vehicle starting from a standing stop might be struck.

It will require considerable time and experience to resolve some of these doubts about the Yield sign. In the meantime, its introduction will be gradual and the results will be carefully watched. On the whole, there is reason to believe that this is one new traffic sign that will be welcomed by the motorist.

# How GLENVIEW is Getting

PHIL HIRSCH



# out of a WATER HOLE

**A** WATER PROBLEM of rather sizeable proportions has been bothering Glenview, Ill., for the past few years. Thanks to judicious planning and some rather extensive additions to the water distribution system, however, village officials are beginning to see daylight. By the summer of 1957, they think they'll have the problem licked.

Like most other communities in a similar spot, the story of Glenview's water woes begins with the exodus to the suburbs after World War II. Between 1940 and 1950, the population of the six-county metropolitan area outside Chicago rose from 4,825,000 to 5,500,000. Glenview received a large share of this influx, considering the village's former size. It had a 1945 population of 2,500, which rose to 6,142 five years later. Today, according to unofficial estimates, Glenview has between 13,000 and 14,000 residents.

This growth had a somewhat drastic effect upon the village water supply. In 1950, the Glenview water department was serving approximately 2,000 customers. By 1953, the figure was 2,892, and in May of this year, there were 3,678 accounts in the department's files. In other words, between 1950 and 1956, the load increased 80 percent, and between 1953 and 1956, about 20 percent.

Despite the increased consumption, water didn't become critically short until the summer of 1953. Continued population growth conspired with an especially hot, dry summer to increase demand and reduce the available supply. The western one-third of the village was especially hard-hit. On each of several occasions, residents in this area were without water for as long as three hours.

Last year was no better as far as cooperation from the weatherman was concerned. However, during the winter of 1954-55, Glenview public works officials had mobilized the attack on the water problem. Their major effort con-

sisted of installing a one million gallon overhead storage tank, together with a 20-in. supply line running from the pumping station to the tank. A number of feeder connections were inserted in this line, adding materially to the amount of water pumped into the western section of town. As a result, the only area that was critically short, and then just a couple of times during the summer, was a few blocks of homes at the western outskirts of Glenview.

Public Works Superintendent Francis V. Zintak could be pardoned, perhaps, for looking at this one remaining sore spot in his domain with a certain amount of resignation last year. "It was one of the few remaining places in the village supplied by a 4-in. pipe," he explains.

"Throughout most of the rest of Glenview, we had at least 6-in. lines in service. However, the fates willed that just in this area that was so difficult to reach with an abundant quantity of water, people with big families would settle. There were more kids per block up there than anywhere else in Glenview."

This thorn in the superintendent's side was removed last winter. The 2,000 ft. of 4-in. line have been replaced with a 6-in. pipe. It is expected that water pressure during the coming years will remain high enough so that the kids won't have an excuse for avoiding the bathtub.

As Glenview entered the summer of 1956, this was the way the water situation looked: There would be enough water for essential needs, but only enough. Lawn-sprinkling would have to be restricted, as it has been for the last two summers, and users of large capacity air conditioning units would have to install water-conservation devices if they wanted to tie into the village distribution system. Plans were well underway to increase the available

water supply so that sufficient reserve would be on hand to take care of extraordinary loads and future growth.

Before this extra cushion can be provided, the neighboring village of Wilmette is going to have to expand its water distribution facilities, for Glenview gets all of its supply from this lakefront suburb. Major bottleneck is Wilmette's filtration plant, which has a rated capacity of 6 mgd.

These six million gallons must supply the needs of not only Wilmette and Glenview, but also those of the nearby Glenview Naval Air Station. There isn't enough water to go around when the thermometer sends the load soaring. To make matters worse, Mother Nature forces the filter plant to waste water during those periods when every drop is needed. Lake algae flourish on the filter beds in hot weather, forcing plant personnel to backwash the filters more frequently. By utilizing its equipment to the fullest, the plant can actually turn out something more than 6 mgd, but the requirements for filter washing prevent anything extra from flowing through the mains.

Because of Wilmette's limited filter plant capacity, Glenview is strictly rationed. Between 6 pm and 9:30 pm, its pumping stations cannot draw any water at all, and from 9:30 pm to 5:30 am, it can take no more than 1,200 gpm. During the remainder of the 24 hours, Glenview can operate its pumps at capacity—3,100 gpm—but, as already indicated, there have been several times when these restrictions have created a hardship.

Constructing the one million gallon overhead storage tank alleviated this shortage somewhat, but it was by no means a full answer. The tank, built by Pittsburgh-Des Moines, stands 137 ft. above the ground. It has a radial cone bottom, measures

77 ft. in diameter and is 30 ft. high.

The tank and a second storage facility — a 450,000 gallon underground reservoir — are normally filled during the off-peak hours. Water flows into the latter reservoir usually between 5 and 8 am, when consumption is lowest and a maximum amount is available for diversion. The overhead tank "floats" on the system — i.e., it is filled as and when consumption drops sufficiently to make part of the incoming flow available for storage. Personnel at the pumping station keep a constant check on this supply-demand situation by watching their pressure charts.

Last summer there was one day when the village used water at the rate of 4,100 gpm. There were 450,000 gallons in the underground reservoir, and another 800,000 in the overhead tank when villagers began flocking to their faucets. By that night, despite the fact that the pumps had been working at their 3,100 gpm. capacity throughout most of the period, both storage facilities were dry.

"Fortunately, we scraped through that crisis with only a minimum amount of trouble," Supt. Zintak recalls. But if the load had gone any higher, or lasted much longer, the consequences would have been far more serious. As it was, we had difficulty supplying water for the next few days. The heat continued and consumption remained high, sharply reducing the off-peak flow available for storage."

Wilmette has launched an ambitious construction program that should eliminate this touch and go situation by 1957; and by the fall of this year, Wilmette hopes to have a new 4 mg standpipe in operation. Glenview will tap the 24-in. main feeding this standpipe.

"With the standpipe in, the load on the filter plant, especially during peak periods, should be reduced," Mr. Zintak explains. "In turn, this will provide more water for our needs. At least some of the restrictions in our pumping station will be lifted and we'll have less trouble keeping water in the underground and overhead tanks."

In 1957, Wilmette expects to increase the capacity of its filter plant from the present 6 mgd to 15 mgd. When this work is finished, Glenview will enlarge its pumping station. Two new pumps will be added, rated respectively at 7,000 and 5,000 gpm., and three existing pumps with a rated capacity of 2,750 gpm. will be retired. An Allis-Chalmers 3,000-gpm. pump, installed last year, will remain in service, together with the

two new units. When this work is completed, station capacity will rise to about 7,000 gpm.

These improvements should keep Glenview abundantly supplied with water until 1960 at least, Supt. Zintak believes. One thing in the village's favor is that it has little remaining vacant land. Thus the frenzied population growth of the past decade is bound to taper off, relaxing the squeeze on the water system.

To make this squeeze less severe, the village enacted the sprinkling ordinance in 1954. It limits use of water for lawns to the hours between 9:30 am and 12 noon, 9:30 pm and midnight. Residents who have even house numbers sprinkle on the even calendar days, those with odd-numbered addresses sprinkle on the odd-numbered dates. These restrictions are in effect between May 15 and October 15.

"The vast majority of Glenview residents have cooperated with the ordinance voluntarily," explains Supt. Zintak. "I would say that most of the village's lawns are watered within the prescribed hours. There has been virtually no need for police enforcement. This high degree of compliance has been a big help in stretching our water supply."

In April, 1955, an ordinance requiring conservation devices (water towers or spray ponds, for example) for all water-cooled air conditioning or refrigeration units with a capacity of two tons or more was passed. New installations were put under this restriction immediately. Owners of existing units were given until March of this year to convert.

The specific limitation, as it appears in the ordinance, reads as follows:

"No water from a public supply shall be used by any air conditioning or refrigeration system having

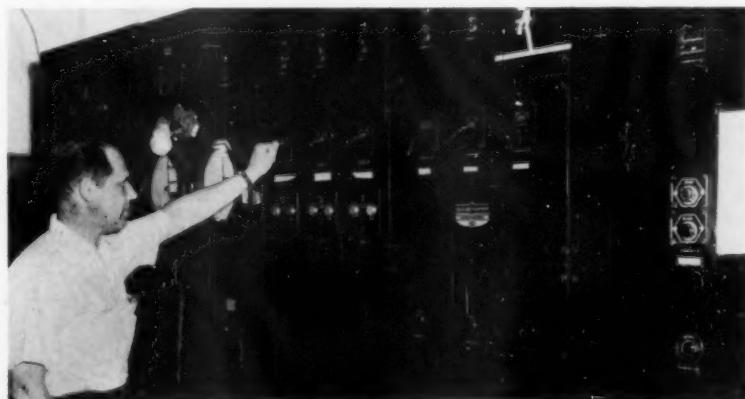
a total rated capacity of two tons or over (per 24 hours) unless said air conditioning or refrigeration system is equipped with evaporative condensers, cooling towers, spray ponds, or other water cooling equipment and water conservation devices. This equipment shall be of sufficient capacity to insure that maximum requirements for make-up water, when operating under full load at maximum summer temperature, will not exceed 0.2 gallon per minute per ton of capacity."

Residents who had large-capacity air conditioning and refrigeration equipment in use before passage of the ordinance were required to contact the public works department. Shortly before the March deadline rolled around Supt. Zintak inspected all of these installations to make sure that conversions were either completed or under way.

In the case of new units, the ordinance requires that the purchaser obtain a permit from the public works department prior to installation. Also he must tell officials when the device is ready to be hooked up, so that an inspection can be made, if necessary, to determine compliance.

"The air conditioning ordinance isn't going to save much water," explains Supt. Zintak. "There are only about 50 units of two-ton capacity or larger in the village. However, we expect Glenview to have a big industrial and commercial growth during the next several years. Most of these stores and plants will almost certainly have air conditioning equipment."

With the ordinance on the books, Glenview's water system should be able to take care of this increased load easily. By then, the village's water shortage, past and present, is expected to be just an unpleasant memory.



● GLENVIEW'S Water Superintendent, F. V. Zintak, operates remote control that puts overhead storage tank on the line. New storage tank is shown on opposite page.



# FUEL COSTS TUMBLE with

## DUAL-FUEL ENGINES

THE POST-WAR YEARS have changed the aspect of power in west Kansas and eastern Colorado. Prior to 1948, rural consumers in this area were paying premium rates for power from a struggling REA cooperative which was on the verge of bankruptcy. Today this same REA co-op is thriving and growing. Its demand is increasing at a rate of 500 kw. per year. Its consumers are paying reduced rates, equal to or lower than those of local public utilities and lower than most municipal power plants. Meanwhile, the once struggling co-op has constructed a new 14,000-hp. generating plant which has become a show-place for the region and a model of efficiency. Its four 3500-hp. Fairbanks-Morse dual-fuel engines are producing dependable power for a 2842-square-mile area at an average fuel cost of only 2.69 mills per kilowatt hour.

The new plant went into operation in the late summer of 1951. In the remaining 5 months of that year it recorded a fuel cost average of 4.40 mills per kilowatt hour. This was only the beginning; the figure was cut to 3.17 mills in 1952; to 2.87 mills in 1953; 2.88 in 1954; and in 1955 a record low of 2.69 mills per kwh.

The effect on total operating and production expenses has been striking. During the plant's first four months in 1951 these expenses averaged 6.3 mills per kwh. By the end of 1955 these had dropped more than 27 percent, to an average of 4.597 mills.

In 1955, the four dual-fuel units generated a total of 31,571,000 kwh, while consuming 142,645 gals. of pilot oil and 349,910 MCF of natural gas. The pilot oil used has a heating value of 139,139 BTU per gal. and the gas a heating value of 841 BTU per cubic foot. Thus, the four engines averaged 11.08 cu. ft. of gas and 0.0045 gal. of pilot oil per kwh throughout the period. Expressed in thermal units, they averaged 9,318 BTU per kw. hr. on gas and 626 BTU per kw. hr. on pilot oil—a combined average of 9,944 BTU per kw. hr.

The biggest load increase came during the first year of operation, when peaks jumped from 3600 kw. to 6000. At an average increase of

500 kw per year, it is expected that peak loads will reach 11,000 kw in 1960 and 13,000 in 1965. These are predictions based on a 1952 study by the REA.

All gas valves are checked at the end of every 500 hours of operation; all fuel injection nozzles are inspected on the same schedule; and the entire engine is thoroughly inspected, including rings and crankcase, every 1000 hours.

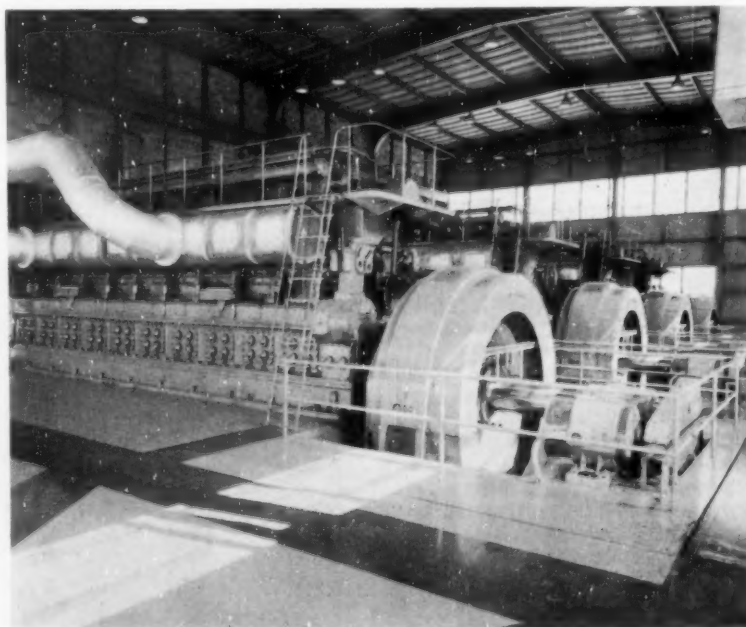
There is a common raw water system for all four engines, built around a cooling tower. Two 12-in. vertical propeller pumps, driven by 60 hp. motors and one 8-in. vertical propeller pump, driven by a 30-hp. motor, circulate cooling water from the tower sump through the jacket-water and lube oil heat exchangers and back to tower sprays. A parallel system with a 1½-in. motor driven pump, circulates raw water through each engine's intercooler.

The scavenging air system for the No. 4 engine differs slightly from those serving the other three engines. Whereas three engines are

equipped with engine-driven blowers, the other engine is provided with a 24-in. centrifugal blower, driven by a 300-hp., 3550-rpm motor.

All power at the plant goes out at 13,200 volts, with the exception of two 69,000-volt lines. Power is stepped up from 4160 volts by separate 3000 kva. transformers installed for each engine. Two 5000-kva. transformers are installed for the 69,000-volt lines. Power is controlled at the plant at a 15-panel switchboard, constructed as a single unit. There are four engine panels, 11 distribution panels and a swinging synchroscope. The board is equipped with pneumatic circuit breakers. All switching is remote and all control circuits are direct current. A 5-ft. tunnel at the rear provides plenty of room for workmen. In addition board's bus bar is 13,200-volts and all switches operate at this voltage.

The plant normally has a complement of 11 men, including the plant superintendent, Wesley Retherford, and two maintenance men.



● THESE four Fairbanks-Morse dual-fuel engines, each rated at 3500 hp at 277 rpm, are responsible for the sharp reduction in operating costs at Wheatland plant.



**LEO J. RITTER, JR.**

Technical Consultant  
Public Works Publications

## Energetic

# PUBLIC WORKS PROGRAM Provides Modern Community

**U**NDER THE guidance of an enlightened Mayor and Board of Aldermen, a very ambitious and highly successful program of public works improvement has been carried out in West Point, Miss., during the last four years. The program has included extensive improvements to the water and sewerage systems, surfacing and resurfacing of city streets, construction of a new utilities building, extension of the street lighting system, and rebuilding of the entire city electrical system.

The program started with a bond issue of \$825,000 and was sold in 1953 for improvements to and extension of the water and sewer systems. Included in this program were the construction of some 19 miles of sanitary sewers; from 8 to 24-inch; laying about 21 miles of water mains, ranging in size from 6 to 12 inches; and the installation of 165 new fire hydrants. At the completion of the program, water, sewer, and fire protection were made available in every block in the city. Water is obtained from wells and requires no special treatment. Future plans include construction of an adequate sewage treatment plant to reduce pollution.

In the last three years, four miles of new paved streets have been provided and paid for by a bond issue of \$146,000. These streets were built with concrete curb and gutter and a hot-mix asphaltic concrete surfacing. In addition, about five miles of city streets have been resurfaced with hot-mix at a cost of \$50,000; costs of resurfacing were met from current revenue.



● CITY UTILITIES building at West Point provides space for several departments.

In May, a new utility building—constructed at a cost of \$50,000—was completed. The building contains 9300 feet of floor space and houses electrical department offices and repair facilities, fire department trucks, court room, and city jail. Completely modern in every respect, the building contains a remote control station for the two-way radio system in use throughout the city. Costs of the building were paid out of current operating revenues. A new, separate fire station will be built in 1956.

## FACILITIES

One of the most interesting phases of the postwar program in West Point has been the complete rebuilding of the city electrical system. This program was begun in 1946 and completed in 1950. Since 1952, the town has become one of the best lighted communities in the Southeast.

Three lighting projects have been completed since January, 1954, in-



● THE ELECTRICAL system has been completely rebuilt and new lights installed. City force account was used for erection of new steel poles and for the wiring.



● SOME of the new mercury vapor street lights installed in West Point, Miss.

volving the installation of 66 mercury vapor lights and 285 incandescent lamps. Both steel and wood poles were used. The lamps were purchased on low bid from the Line Materials and General Electric. The incandescent lamps installed under two of these projects are 500-watt units. Erection of poles and wiring was done by force account, using the city's own crews. One of the projects utilized neoprene-coated underground circuits in the lighting of a new subdivision.

The latest project, completed this spring, involved the installation of 46 mercury vapor lamps on U.S. highway 45-W, within the city limits of West Point. General Electric multiple lamps (120-volt) were used; 36 of the luminaires were mounted on steel poles erected on concrete foundations, and the remainder on wood poles. Erection and installation were done by a crew consisting of a foreman and four men, using a 1½-ton Ford truck fitted with a McKay-Powers body. Spacing of the poles is about 125 feet. Total cost of the project — including materials, labor, and supervision—was \$14,000. Total cost of the lighting program to date has been approximately \$58,000.

Incandescent lamps used in lighting residential areas are controlled by photo-electric cells mounted separately on each fixture. The cells automatically switch each light on as the intensity of light diminishes at dusk and turn the lamp off as the intensity of light increases at dawn. An advantage of the use of these units was that it permitted the use of existing sec-

ondary circuits for off-peak load.

In the near future, 30 additional mercury vapor lamps will be installed on highway 45-W, and 20 additional incandescent lamps in a new residential area. Addition of these units will complete the planned lighting program, with every street in West Point well lighted. During the program, older

fixtures were moved and used in outlying residential areas, and in alleys and dark, behind-building, areas in the downtown district. Results of the modernization of the lighting system have been spectacular—police records show that crime (break-ins, fights, gambling, drunkenness) in West Point has been reduced 50 percent by the lighting program.

As previously emphasized, rebuilding of the electrical system and the lighting program were carried out by the use of current revenues from the electrical system. Power is purchased from the Tennessee Valley Authority, and West Point shows one of the highest ratios of net profit to kilowatt-hour of power consumption in the entire TVA system. Despite the extensive program of public works improvements in recent years, the bonded indebtedness of West Point remains one of the lowest (for cities of comparable size) in Mississippi.

Since July, 1953, R. B. Marshall has been Mayor of West Point; it is under his leadership that most of the projects described have been carried out. M. W. Tillman, an employee of the city for 28 years, is Superintendent of the Water, Sewer, and Light Department.

## FCDA Program for Packaged Water in Disaster Areas

THE Federal Civil Defense Administration has enlisted the support of the nation's dairies and their allied industries in a program designed to assure the speedy delivery of safe drinking water, packaged like milk, to stricken communities in the event of natural disaster. The program, worked out with the milk industry, container manufacturers and representatives of national organizations, proposes that, in any emergency, dairies in areas affected would package water in containers usually used for milk for shipment by air, rail, truck or water to the disaster regions.

It would be the responsibility of the civil defense director in any community where the water supply was inoperative to determine the need for drinking water and the amount required. He would appeal to the nearest dairies still in operation and make arrangements for packaging and shipping the drinking water to his community.

Several companies are using hand stamps, special caps or inserting the regular cap upside down to identify the specially-packaged wa-

ter. Two companies are producing special cartons.

The idea of using drinking water packaged in milk containers to aid a helpless community was introduced at Stroudsburg, Penn., in August, 1955, when that city was flooded by Hurricane Diane. With the Stroudsburg milk plant out of operation, an appeal for milk cartons to be used as water containers was made to the Lehigh Valley Cooperative Farmers Dairy at Allentown, 30 miles away. The Allentown dairy not only sent the cartons, but filled them with water to avoid the possible contamination that might have resulted from manual filling in Stroudsburg. The filled cartons were trucked to Stroudsburg and distributed to flood victims.

After the success of the Stroudsburg experiment, FCDA officials consulted with representatives of the dairy industry and health and relief organizations with a view to perfecting the program so that it could be used in areas affected by flood, fire, hurricane, tornado, earthquake, explosion, or drought.



● CAMERA records the complete story of a violation as motorist illegally crosses the solid barrier line on highway.

## TRAFFIC CAMERA RECORDS VEHICLE MOVEMENTS AND SPEEDS

USE OF a traffic camera, a simple and effective device, has helped North Carolina reduce traffic fatalities. A six-month period of use saw such fatalities reduced to 991, compared to more than a thousand for similar recent periods. Use of this camera resulted from a decision by Ed Scheidt, State Motor Vehicle Commission, to try them out. Two cameras were leased and put into use by the state patrol. After first favorable results, the number of cameras in use was increased.

The cameras are bolted to the roof of the patrol car and suspended inside the car. They "shoot" photographs through the windshield to show graphically and record permanently a vehicle's position on the road; weather, traffic and highway conditions; road signs; and rate of speed. This last is accomplished by an optical arrangement within the camera which superimposes on each negative a police checked speedometer, a watch or clock, an odometer and a slot for the date on each negative showing when it was exposed. Successive negatives may be taken and projected on a screen showing how the vehicle is being operated.

A switch on the gear lever of the car turns the camera on. Electrically driven, it uses 35 MM film and

operates at the rate of 16 frames a second. A portable developing kit, carried in the car, permits making a negative in a few minutes, if this is necessary or desirable. So far prints have not been used in court cases.

The camera which is leased, not sold, is known as the Markel traffic camera. It has been used by the Markel organization for checking and studying the operation of buses and trucks.

● SPEED, time, date and view through windshield are photographed by trooper.





# LANDSCAPING WATER AND SEWAGE TREATMENT PLANTS

**STUART M. MERTZ**

Landscape Architect

St. Louis, Missouri

Member—American Society of

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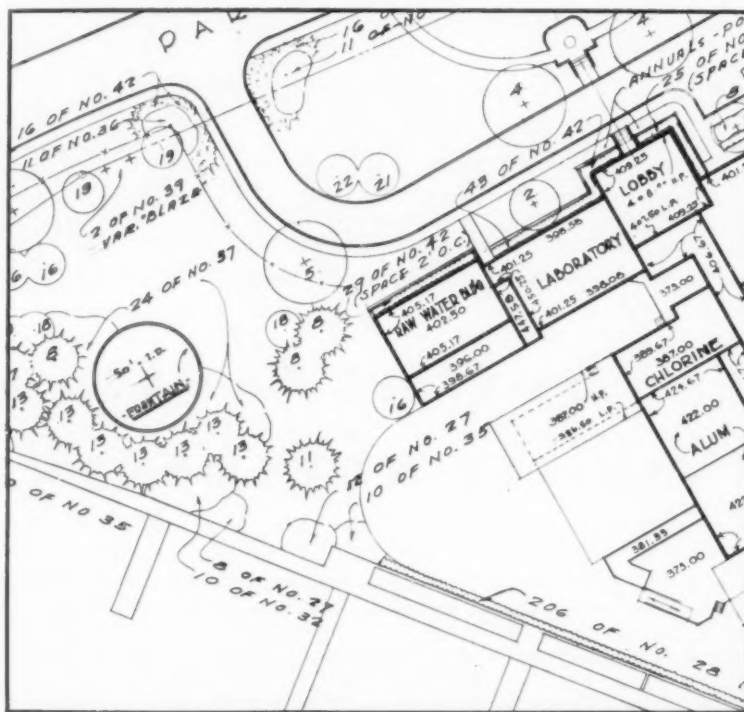
**W**HY PLANT ANY installation or building? If you can answer that question, then you can answer why a water treatment plant or sewage disposal plant should be planted.

Everyone likes to live in a community of beautiful homes and surroundings and while the types of utilities we are discussing are often on the edges of our communities, they should blend in with the surroundings and not be incongruous. If a water plant is in an area surrounded with other buildings, or factories, or even homes, it should beautify its setting. Psychologically an institution or building offers good public relations if it has a fine setting, blending with the surroundings, maintained to the same or better degree than the homes or other buildings in the area.

People think well of beautiful things, and planting certainly adds to something that is normally not an architectural thing of beauty, such as a disposal or treatment plant. A fine architectural effect can be obtained on a big plant in a large city; but many smaller plants have hardly more than a one-room building which may be lost on the site in comparison to the area of the filter beds and tanks.

But to what degree should such a plant be landscaped? How far should a city or company go in its efforts to beautify its grounds? This naturally depends on the local situation. A plant for a rural community on the edge of town might need only some trees to create a satisfactory setting. Perhaps some screen planting of evergreens along certain areas might enhance it in winter as well as in summer.

If the same small town had a plant more in the center of the town, it might require more low shrub or evergreen planting as well as trees



● PORTION of landscaping plan for Baltimore's Ashburton Filtration Plant, prepared by Martin Funnell, Landscape Architect for Whitman, Requaardt & Assoc. Deciduous trees, evergreens, minor trees, shrubs, vines and groundcovers are specified.

for shade and setting. Obviously enough land should be available to provide such a setting without crowding the working units or causing extra maintenance or operating cost by the leaves that might fall from time to time. And if the land isn't available, then one has to use even more ingenuity to create something in a small area. This might be done with vines on fences, narrow trees or shrubs or a combination of all of them.

## Advance Planning

Officials should always purchase enough land, as one can never tell when a town will suddenly grow up all around a plant that was thought at one time to be far out in the country. When this happens, a wide planting belt around it may provide a buffer zone and relieve the awareness that the plant is there. It helps to maintain property values and to

prevent creation of areas which loan agencies might classify as "undesirable".

This is particularly true of minor plants, such as pumping stations and secondary offices or elevated tank locations. Some cities have designed pumping stations like houses, complete with landscaping, so that they fit into the neighborhood. Personally I think a utility building should not look like a house; it can be designed attractively to blend in with the local residential section.

This leads to a pertinent question—is the landscaping worth the extra cost of maintenance? Psychologically and physically I think anyone will agree that it is. If one has the acreage, it has to be maintained as grass. Grass is an important part of landscaping. To control erosion and dust are two of the best reasons for having lawns. Trees form another basic element of a plant setting for any



building. Well selected trees that live long, grow relatively slowly; don't split up in every wind or ice storm; and have a minimum amount of seeds, nuts, or other fruit, and few diseases and insect infestations are the ones to use. Ground forms can do much to create a beautiful setting, particularly on sloping or hilly sites. Proper grading and design can eliminate a lot of planting and maintenance.

Flowering shrubs, flowers and evergreen shrubs have a place in the composition in certain locations. Many cities in the spirit of public relations have created parks around water installations, and all types of plantings are used. Sometimes an existing condition on the site, such as the old quarry at Des Moines, Iowa, can be turned into a decorative asset. Properly designed, these do not necessarily involve high maintenance costs. Proper design implies consideration of local maintenance cost. Each situation has different requirements and thus must have a different solution.

Just as you hire an experienced engineer to design a plant, or an architect to design the building, so should you engage the services of a landscape architect to design the landscape development, which includes ground forms, access, fencing and planting. Best service can be rendered when the landscape architect is called into the picture when planning is beginning, not after the

plant is constructed. Full value from any service can be procured only when the full scope of the designer's talent can be called upon from the beginning of the project.

### **Be Sure to Have a Plan**

There are many examples of well landscaped installations throughout the country. Many have grown through a period of years, with some planting added year by year as funds are available. Wise officials know that even though they can't afford a complete planting job at first, if they have a complete planting plan to work with, they will have eventually a coordinated and unified planting program which will give a good esthetic effect and will be economical to maintain.

The Des Moines, Iowa, plant is an example of fine landscaping. Another plant showing excellent use of native trees, and preserving as much of the existing foliage as possible, is the new Filter Plant No. 2 at Austin, Texas. Tanks are set into the bank but exposed parts of the wall have been planted with ivy. Foundation planting around the building consists of cactus and other shrubs that resist drought, even though the plant has underground sprinkler systems. Additional naturalized planting will be added later.

The new Ashburton plant at Baltimore shows that a fine architectural design can be achieved. The entire site was carefully laid out and an

overall landscape design made by a landscape architect. The plan provided strategic planting for screening, for enhancement of the buildings, as foundation planting and as a background for the fountain. Vines were used on the stone wall, climbing roses on the fences around the plant.

### **Fencing for Utility Plants**

Fencing around plants is an important element of the installation. It is not only protection for the plants from intruders, but it protects children and pets from danger. A well designed fence blends with the surroundings and when combined with the planting creates a pleasing effect. Chain-link fencing is the cheapest of the long lasting maintenance-free fencing. For complete safety, a fence six feet high is necessary, though many plants have them seven or eight feet high.

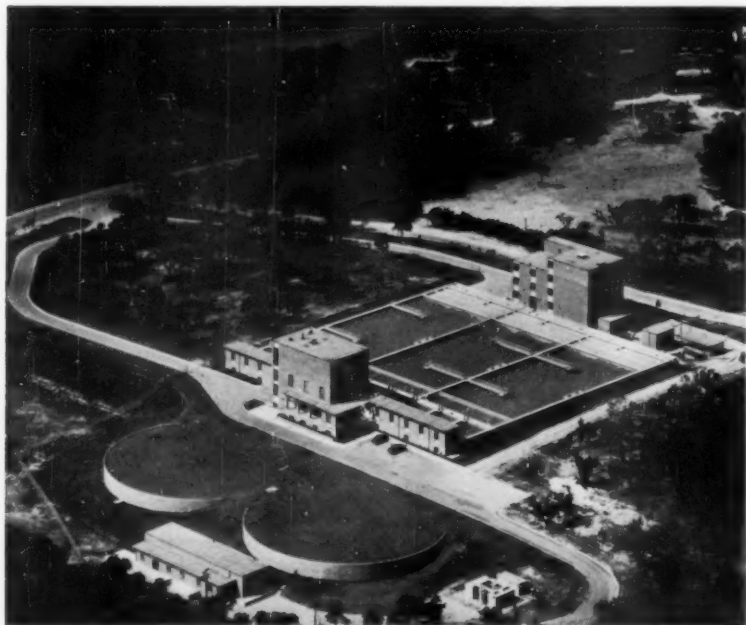
It is best to design the fencing with the planting so that the combination of the two will create a beautiful effect. On a restricted site, such as the Ashburton plant, the fencing generally follows the property line, leaving sufficient room for planting of a park-like nature. This can also reduce the amount of fence to be installed and maintained.

When fencing is necessarily located in restricted places, different kinds may be used, such as iron picket fencing. This type is used as a part of the entrance gates in the Des Moines plant. Such a fence is decorative but not likely to make the installation look like a prison yard. It requires less planting, and thus its higher initial cost may be offset in less planting cost and less maintenance cost.

Other types of fencing that can be used are cedar-pickets, split log rails or, in restricted areas, a custom-designed fencing for special screening or architectural effect. Cedar-picket fencing comes in varying heights and will last up to 25 or 30 years. It is a fine fence where screening is desired in restricted areas and in areas adjacent to residential property. Posts are usually six or seven feet apart.

Split log rails are for decorative effect only under certain conditions. They keep out nothing, but when combined with planting create a fine landscape effect. There are times when marking the boundary of a site is desirable even though the protective element is not paramount. Best effects are obtained from rails seven feet to ten feet in length.

Masonry walls of either brick or stone are almost prohibitive in cost.



● ATTRACTIVELY landscaped filtration plant blends harmoniously with its surrounding residential neighborhood. This is the Austin, Texas, Filter Plant No. 2.

They may be used in various locations if small quantities are needed for special effect. The cost of a six-foot high masonry wall would be approximately \$30 per lineal foot, including the foundation, compared to \$3 or \$4 for chain link or cedar picket fence.

Lawns make up the major first expense item in most landscape development work. Since the climate of the country varies so much, it is impossible to recommend the proper grass seed mixture. St. Augustine grass in the extreme south blends into Bermuda Grass in more northerly southern states, and into the basic Kentucky Blue grass mixtures of the northern climates.

It is well to follow some general methods of procedure in all climates, however. Soil tests should be made to determine the relative acidity of the soil, and the amounts of available chemical fertilizer in the soil. Tests may be made to show the relative amount of organic matter or humus in the soil, though rectifying a deficiency in humus is a costly affair as a rule. When these facts are known the proper fertilizer can be prescribed and the necessity of using lime determined.

The proper grass seed mixture should be designed to fit the conditions. If extensive acreage is involved, careful tailoring of the mixture will save on costs as compared to using a general all-purpose seed mixture sold by most seed houses.

All areas to be seeded should be well tilled prior to the seeding operation. Plowing, discing and harrowing are essential initial steps in properly preparing a seedbed. Deep discing in lieu of plowing may be satisfactory in many areas. After one or two passes of the disc over an area, ground agricultural limestone should be spread, then the fertilizer, and all thoroughly disced into the soil. Final smoothing is usually done with a harrow or a drag and harrow.

Seeding with wide mechanical spreaders in two directions at right angles to each other is a most efficient method of broadcasting seed. Light rolling after the seeding is most important to firm the seed into the soil for quicker and complete germination.

Cut the grass long at first to give it a chance to make a heavy root growth and become well established. In many areas the grass may be kept as a meadow, cutting it with a sickle-bar mower once a month instead of with an ordinary type mower every week. In the south the special grasses need different treatment, normally more frequent cutting, and closer to the ground.

Where danger of erosion is prevalent on banks, sod is by far the best method of covering the soil with turf. It costs more, but saves the maintenance costs that come from eroded banks. Sprigging and plugging is required of certain grasses in the south instead of seeding or sodding.

It is recommended that a local landscape architect be consulted for local costs on this type of work. In St. Louis, for example, normal Blue-grass seeding runs from 10¢ to 20¢ per square yard, depending on the amount of fertilizer and humus needed. Sodding runs from 35¢ to 60¢ a square yard depending on the quality of the sod and the condition of the ground. On the average we figure about 12¢ and 50¢ respectively for a complete job under normal conditions.

Your local County Agricultural Agent can also assist you on problems concerning lawns, though he may know more about pasture grasses than lawn grasses. He can help you with soil testing and other matters of supply and tilling.

It is difficult to generalize on planting unless one picks out a specific climate zone. But as a guide for trees to plant, use the best trees in

the area for street trees. These are usually slow growing, long lasting and as maintenance-free as a tree can be. Shade trees and flowering trees that are recommended by your City Forester or Park Superintendent for this purpose should comprise the main varieties on the tree list. This is also true of evergreen trees, evergreen shrubs and flowering deciduous shrubs.

Flowers should be used in moderation because of the high maintenance cost involved. In past years many installations have had rose beds, canna beds, or other flower beds in the middle of the lawn in front of the main buildings. Today the vogue is plant boxes as a part of the building. Actually from the design viewpoint, flowers should be used in connection with the rest of the planting. Trees, shrubs and evergreens should form the basic year-round effect. If flowers are added for color and a change of scene during seasons when they thrive, they should be designed to fit into the general mass planting of the scene and not to take all interest away from the main center of interest, usually the building at the plant.

Beds should be arranged so that in winter, in northerly climates, they will not leave a large unsightly bare area. They should be simple in shape, the varieties should be few in number, even all of one variety. Massed annual bedding plants usually give the best flower displays. There are many places where spring flowering bulbs such as tulips and narcissi can be used. The latter require less maintenance care and replacement. To have a good show of tulips, they must be replaced almost every year, particularly if in symmetrical or geometric designs.

Costs in tree planting vary depending on how large the plants are that are planted. The important point is to budget something for planting at the beginning of the planning program and to keep this item throughout the program. Too often costs of construction run over the estimate and the first thing to be eliminated is the planting. It should be retained and developed from year to year if it cannot be afforded all at once. Planting appreciates with time; buildings depreciate with time. Planting makes for pleasant surroundings and environment, it is the difference between the ordinary and the beautiful. Make your planting an asset to your community, and make your plant a well-received part of your community life by having it well planted and well maintained.



● LANDSCAPED entrance to Construction Dept. office, Des Moines Water Works.

**J. CARL McMONAGLE**  
Assistant Director  
Highway Traffic Safety Center  
Michigan State University  
formerly Director,  
Planning and Traffic Division  
Michigan State Highway Department



● NEW pedestrian signal prepared for experimental installation. Maize and blue are the colors suggested to replace customary red and green and avoid conflict with vehicular traffic signals.

## BASIC DEVELOPMENTS IN TRAFFIC CONTROL DEVICES

**A** GOOD BASIC law providing concentrated authority; continuing research; and a working partnership with the motoring public in the operation of regulations in the public interest, are Michigan's principal assets in the field of traffic control.

Michigan recognizes that the problem of traffic control is not static, but that it is dynamic, changing with a variety of conditions and considerations. Public agencies, through their traffic and planning units, pursue, in the study and search which the ever-changing times demand, research in materials, methods, driver habits and an infinite variety of additional facets of the highly complex problem.

Taking the public into the confidence of the highway administrator is a valuable tool in traffic control. Making a partner of the driver by providing him with all of the information available and then enlisting his willing cooperation can frequently prove more productive in moving traffic safely, efficiently, and economically, than all of the mechanical equipment which can be utilized in a specific situation.

Traffic signals, signs, and markings have come to be almost completely standardized through the cooperation of the American Association of State Highway Officials, the Institute of Traffic Engineers, and the National Conference on Street and Highway Safety. Michigan has contributed materially to this movement for nationwide standardization; the publication in 1939 of the original edition of the manual prepared under the joint authority of the State Highway

Commissioner and Commissioner of Public Safety marked the first authorized step toward statewide uniformity in the design and use of signals, signs and markings.

While traffic signals and signs have become almost completely standardized, and wholly commonplace to the great body of American motorists, it is also true that they have, to a considerable degree, become obsolete. Like two-lane pavements on heavily travelled trunklines, which no longer can carry the traffic that wants to use them and which, as a consequence, are being replaced with divided four-lane or six-lane super-highways, many of our signals and signs do not meet the requirements of this modern traffic. Signs which were easily visible, and which caught the attention of drivers when average highway speeds were much lower than they are today, do not have the required visibility and legibility to serve an adequate traffic-control function when drivers are hitting the 60 to 70 mph speed, now the rule rather than the exception.

Likewise, visibility and legibility of the signs and signals which were designed a decade or longer ago, suffer today because of the increase in volumes of traffic. The driver who is competing with thousands of other drivers for roadway space, and who is attentively occupied in driving his car on a crowded or overcrowded highway, doesn't have time or opportunity as he did a few years ago to check the signs and signals along or above the right-of-way.

America is producing more cars, and higher-powered cars, than

ever before. Highway agencies are designing and building more and better highways than we had in the past. But to too great a degree we are still trying to operate traffic safely, efficiently and economically with Model T devices. We are faced today with an acute requirement for more modern methods of traffic control, because of the increase in vehicular usage and miles of operation, and we face the same requirements for more modern devices.

To meet these requirements, the traffic engineer fills the necessary role—having earned recognition for his sometimes heroic efforts in keeping an inadequate and outmoded highway system in operation, he is now being recognized as a highly competent practitioner in the field of research into advanced methods and improved materials and equipment to solve the problems which the ever-increasing traffic streams create.

In this vein, it appears obvious that the first requirement of any street or highway administrative agency in the attack on adequate traffic control problems, is the services of a traffic engineer. The best of traffic control devices are still mechanical; the contribution of his own experience and the accumulated experience of thousands of others in his field of activity by a traffic engineer will create a workable system. Mechanical devices without the benefit of the intelligence of the trained human director, are of little value at best; and at worst the mis-use of devices by unskilled direction can easily create more, rather than fewer, hazards.





● PROPOSED design for urban expressway lane and speed control. The overhead signals are illuminated. Access for maintenance purposes will be provided from truss.

There are new and promising developments on many fronts, which are worthy of considerable attention. Following are rather brief explanations of those more recent advances which have come within our cognizance.

### Traffic Signs and Signals

Traffic signs are placed along a roadway to inform vehicular traffic of regulations governing movement, to warn of potentially hazardous conditions, and to provide guidance and information. Their use should be based entirely on facts and field studies.

With respect to signals, general policy conforms to the following: "Highway signals are power-operated devices, except signs, by which traffic is warned or permitted to take specific actions. Again, it is of the utmost importance that erection of signals proceed only after specific studies determine the type and need. The traffic signal is one of the most efficient of traffic control devices, satisfying the dual need of safety and facility of movement for both vehicles and pedestrians, when properly installed under conditions justifying usage."

A notable advancement in recent years is the research into, and development of, overhead signs.

Overhead signs, hung from rigid supports, are coming into general usage because of their high visi-

bility under most conditions of speed, light, and weather. They are particularly adaptable to modern expressways where uniformly high speeds are maintained, where directional information must be prominently displayed, and where driver distraction must be held to the irreducible minimum.

These signs are useful for display of lane positioning information, for complicated interchange or intersection identification, and for direction and route marking, among many possible usages. Supports may be of steel or aluminum, and in Michigan the color pattern includes white lettering on green background.

Recent research here indicates that letters should be 15 to 24 ins. high, and it is expected that the 15 to 24-in. dimensions will be adopted as standard for expressway installations.

It should be noted that the warrant for overhead signs is inherent in the fairly recent progression to multi-lane highways. On four-lane undivided highways, roadside signs do not adequately cover traffic on the inside lanes; the same is true on divided highways if the median strip is too narrow to accommodate the required signs. On divided six-lane highways, the center lanes are shielded from right-of-way signs erected on either side.

In these cases, the overhead sign is mandatory to good traffic con-

trol; and the fact that the overhead sign can be much larger in size, plus its advantage of positioning directly before the driver and in his direct line of vision, are additional desirable qualities.

Under study at the moment is a further advanced development of the overhead sign for expressway use, in which the sign is combined with power signals. A sketch of the proposed combination is shown at the left.

On high traffic volume sections of expressways, it is sometimes advantageous to be able to direct drivers from one lane to another, to require reduced or increased speeds, and in some cases to direct all traffic off the expressway temporarily. Such instances might include: an accident, blocking one or more lanes, requiring that traffic shift lanes, and reduce speed; bad icing, with accompanying requirement for reduced speeds, or high traffic density in which moderate speed reduction is indicated; and, in an extreme, a particularly bad accident or series of accidents blocking the roadway completely, in which case a serious traffic-tie-up can be avoided only if the whole traffic stream is diverted off the expressway.

Notable in the details of the overhead sign-signal are: a fixed span, permitting maintenance access to the signal installations; a green arrow and an amber cross mounted over each lane; and a variable speed control indicator, mounted centrally.

Since the signals are illuminated from within, utilizing neon high-intensity tubes, access must be provided for service and repair. The span will provide a catwalk or other means for maintenance personnel to service the installation, which obviously could not be reached by any other method while moving traffic passes underneath.

The side-by-side cross and arrow provide lane control. The green arrow, when illuminated, will denote clear roadway ahead. When a lane is blocked, by accident or otherwise, the illumination will be switched to the amber cross, warning drivers to move to another lane.

Suggested speed controls, which will finally be determined after field testing, are 25 mph to be used for partial obstruction of the expressway or when conditions such as heavy icing make normal speeds hazardous; 40 mph for high traffic periods; and normal maximum of 55 mph permitted on urban expressways in Michigan.

● THIS TYPICAL overhead sign used by the Michigan Highway Department displays route information prominently. Pictured is aluminum truss on divided highway.





Similar combination sign-signals may quite possibly be used for reversing lanes, operated in some cities.

Control of the signals is another research project. We are interested in radio control, from a central station, from which many sign-signals covering an entire metropolitan area might be operated. A further possibility is that television monitoring of expressway traffic, now being studied in many cities, may be combined with radio control of the system.

A problem inherent in overhead signs is that of proper illumination at night time. After-dark expressway traffic, except where an exceptionally wide median strip is provided, operates on low-beam headlight lighting. The depressed beam does not reach the overhead sign, as it does the roadside sign, and consequently reflectorization provides no assistance in visibility. It is indicated, therefore, that the signs will have to be illuminated by some method now being determined.

To date, most overhead signs have been literally custom-made. We should shortly have sufficient accumulated experience to standardize specifications for materials, colors, and dimensions, on a nationwide scale.

The problem of protecting school children at crossings is one of the most important we face, and one in which the general public has tremendous interest. Obviously, we cannot place a stop signal at every intersection in every school area because they are not warranted at all intersections. There are many considerations involved: Cost, interruption of traffic, and intermittent use, are a few. A newly developed sign-signal is one possibility in the field of control and regulation. In limited usage and with only preliminary study available, no conclusions are yet possible, but it does appear to have potential value.

The feature of the installation is the illuminated flasher and speed control figures. Illumination is manually controlled from a switch located in the school building, and operated by a member of the school faculty. The flasher is operated only at those periods when students are actually using the crossing. Control could, alternatively, be operated by a time clock. Without the operation of the flasher the control feature is removed, leaving only the "School" "Speed Limit" legend visible. The sign-signal combination is erected at a

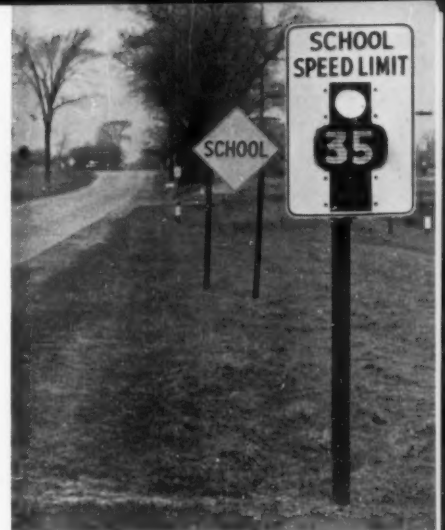
point 1,000 feet from the school, at the standard 10-foot location from pavement edge. Speed checks made six weeks after original installation showed a desired and desirable speed reduction in fact. Further interval studies will provide data on probable permanent control results.

Traffic engineers are working on many variations of sign and signal combinations in an effort to simplify and improve traffic control. One subject of experiment is the placement of guide, regulatory, or warning signs for intersection control in close proximity to overhead signals, rather than at eye-level on the right-of-way. The advantage of concentrating signs and signals in a single location is that they are easily and quickly perceptible, relieving the driver of the necessity of making multiple observations at intersections while under the stress of many other operational requirements. Provision is made for sign illumination at night.

Under a recent Michigan law, all traffic signals must be installed overhead, at or near the center of the street, road, or intersection; all present pedestal-mounted vehicular signals must be replaced by the overhead type on January 1, 1958; and the overhead signals must be dual or more, facing in each direction of traffic movement.

This legislation was favored by traffic engineers as contributing to more safe and efficient traffic control. Objection to the pedestal vehicular signals is that their competitive position restricts visibility and contributes to accidents. Overhead signals, particularly in dual combinations, provide much greater visibility to moving traffic, and permit quicker and sounder decision by the driver.

The legal requirement of dual or more heads has led to new experimentation on signal mounts. The interesting installation shown



● ILLUMINATED school speed control sign-signal. Illumination of the flasher and speed limit can be controlled either manually or by clock.

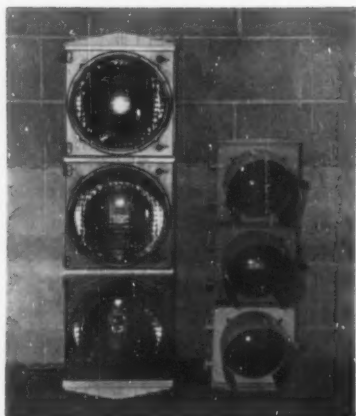
below includes posts on opposite corners, connected with an aluminum tube span from which the signal heads are hung. Power wires are run through the posts and tube to the signals, rather than underground; and there are no cables to wear or break. In the long run, this type of installation is expected to be less expensive than the standard cable span because of lower maintenance cost, and through elimination of costly underground work. The overhead tube, incidentally, has openings in the bottom to permit air circulation and prevent moisture condensation, while providing outlets for the cable to the signal heads.

Oversize signal experimentation is progressing, with studies to date presenting very favorable possibilities. In present experimental installations the standard eight-inch lens is replaced with a 12-inch lens, providing greater visibility and improved control.

Similar studies are in progress on larger turning arrows. In Michi-



● SOLID aluminum tube spans this intersection and carries dual traffic signals.



● **OVERSIZE** lens in experimental signal gives greater visibility and improved traffic behavior. Compare 12-inch lens with standard 8-inch size.

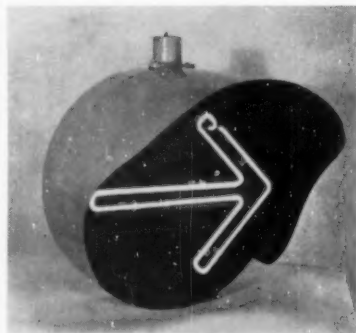
gan we are working with an 18-inch arrow, using both single and dual stroke neon exposed tubes. Another experiment with arrow signals utilizes a neon grid tube for high intensity lighting, back of a glass face having a 15-inch exposure.

Since conclusive evidence has not been obtained from preliminary studies of oversize signals, no policy has been stated. Advanced studies now in progress will provide the necessary data from which future policy will be determined.

With vehicular signals removed from the pedestals, in Michigan, we are now free to proceed with advanced studies in pedestrian traffic control in which we can monopolize the pedestal mounts. One avenue of inquiry and test is the use of colors other than the standard red, green and amber of the vehicular signal, to avoid conflict. Blue and maize appears to be a likely combination. Use of neon tubes, neon grids, and larger exposure areas is being investigated. And there remains an inviting field for study in time cycling and coordination between vehicular and pedestrian signals, both to provide better traffic movement and to protect pedestrians.

### Channelization

Channelization of intersections at grade has been defined as "the separation or regulation of conflicting traffic movements into definite paths of travel by the use of pavement markings, raised islands or other suitable means to facilitate the safe and orderly movements of both vehicles and pedestrians."



● **EXPERIMENTAL** turn arrow has 18" exposure and a dual stroke neon tube.

The history of this tool in traffic control dates back to about 30 years; the first literature on the subject was published in 1939, and the first major installations were designed in 1940. Highway and traffic engineers are focusing special attention on intersections where the major points of traffic conflict and congestion are located.

A disproportionately high percentage of traffic accidents occur at intersections; and intersections are usually a restrictive factor on highway capacity. Expert and judicious use of the many physical means of channelization can reduce accident ratios, and promote higher capacity of intersections.

First brought into usage to control, protect, and expedite traffic at so-called "problem" intersections—the "Y", offset, and multi-legged types—channelization in its evolution as an important tool in traffic planning and control has progressed in recent years to improve traffic flow at square or right-angled intersections, particularly where a large paved section is included. In addition to painted lines on pavements, and raised

"islands" of many contours and sizes, channelization includes such more recent developments as sheltered left-turn lanes, restricted right-turn lanes, physical prohibitions to turns, and many other valuable usages.

By and large, the traffic engineer has two primary objectives in traffic planning and design for intersections:

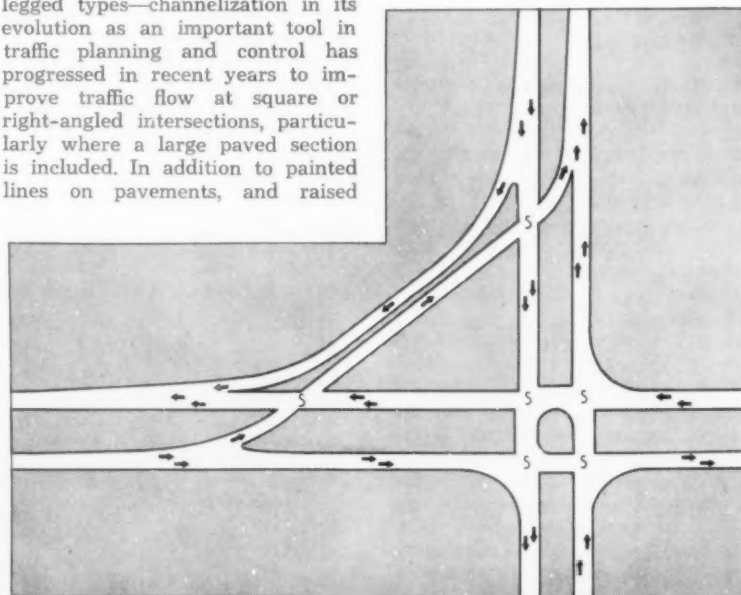
1. To eliminate as many points of traffic conflict as possible; and to separate the conflicts into single, simple crossings.
2. To expedite the flow of the heavier volumes of traffic.

Channelization can assist in both objectives. Re-location of short sections of roadway, in some cases, is expedient. In others a simple one-way traffic movement can be provided. In still others, the addition of a separated turn lane is advantageous. All are forms of channelization.

Of very recent date, channelization is being used in some phases of roadside control. Strategically placed islands control traffic movement into and out of filling stations and other establishments, prohibiting chaotic, irregular and uncontrolled access to and from the highway.

The modern trend to location of large shopping centers away from the central business districts in municipalities provides an opportunity for the traffic engineer to plan control systems which will

(Continued on page 168)



● **EXPEDITING** traffic flow. A heavy turning movement may be detoured around an intersection by use of channelization. Signals are placed where conflicts remain.



● INDUSTRIAL growth in recent years has transformed Calvert City, Kentucky, into a thriving, progressive community.



● THOUSANDS of feet of vitrified clay pipe were installed to provide a sanitary system to keep pace with new industry.

## CLAY PIPE SANITARY SYSTEM *helps* CITY TO CONTINUE GROWTH

IN THE BRIEF SPAN of years since 1949, the small one-time dying-on-the-vine farm community of Calvert City, Kentucky, has grown into a fair sized chemical empire. This village lies in a fold of low Kentucky hills, just a short distance from the Tennessee River. It has slumbered through the years as a farming town with an agricultural economy, a whistle-stop on the railroad.

Of late, plentiful power at relatively low cost available from the nearby TVA system, convenient and economical transportation provided by barges on the Tennessee and Ohio Rivers and by the Illinois Central Railroad, and supplies of chemical raw materials within easy shipping distance have combined to make this a favored spot for rapid industrial growth and diversification.

When four large companies, The Pennsylvania Salt Manufacturing Company, The National Carbide Company, Pittsburgh Metallurgical Company and B. F. Goodrich, moved into Calvert City and began building plants, the town sprang to life and developed into one of the most promising chemical centers in the United States.

Of all the problems pertaining to this growth, that of providing adequate sewerage facilities to meet industrial and community require-

ments loomed as the largest. Prior to the entrance of big industry into Calvert City, the town had nothing in the way of sewage disposal systems other than septic tanks and in many cases these were proving inadequate. After an investigation of existing conditions by municipal officials and engineers of the respective companies, it became apparent that a proper sewerage system would have to be installed as housing developments for employees were built, and as new plant expansion took place.

In March, 1954, a \$365,000 Water and Sewerage Revenue Bond Issue was passed to provide moneys for a water system, disposal plant and sanitary sewer system.

The sewage disposal plant provides for an 80 percent or better BOD reduction to prevent nuisances and possible damages to riparian owners along the receiving stream. A treatment plant was designed to serve about 500 connections, with provisions made to increase the plant capacity by phases in proportion to the number of future connections made to the sewers. The collector system, vitrified clay pipe throughout, included over 20,000 feet of 6, 8, 10 and 15-inch pipe.

Customers pay a sewer usage charge similar to water service. They pay for service rendered. Water going into a home must, of

necessity, leave the home. Thus, water and sewers are inseparable and rates are predicated upon a metered water system. The rate for sewer service is based upon the amount of water going into a home with a minimum monthly charge. The customer pays on the basis of one-half of the gross water bill, or \$2.90 a month minimum, whichever is the higher.

The treatment of industrial wastes proposes no problem for Calvert City. Each of the companies provide its own facilities. The industrial waste of the Pennsylvania Salt Manufacturing Co.'s works consists of dilute solutions of inorganic acids and alkalis. These are combined, neutralized, and discharged into a settling basin of approximately 50 acres in area. The effluent from this lagoon, which is neutral and free from suspended solids, is discharged into a second settling basin of approximately 30 acres in area. Industrial wastes from the B. F. Goodrich company are treated to be harmless to fish and wild life and are then discharged directly into the Tennessee River. Waste from the National Carbide operation is treated in storage lagoons and allowed to dry. It is then used for dikes to enlarge the storage area. Complete disposal units handle waste material from the Pittsburgh Metallurgical operation in much the same manner.



# ENGINEERING GOES TO SEA

## *Los Angeles to Construct Longest Ocean Outfall for Digested Sludge Discharge*

DAVID R. MILLER, Assistant Project Engineer, Hyperion Engineers

WITH THE RECENT award of a contract for \$2,526,044, the City of Los Angeles will proceed shortly with the construction of an ocean outfall for the purpose of discharging digested sludge into the waters of the Pacific Ocean through an outfall 6.75 miles in length. The depth at the outfall terminus is 300 feet. This will be the longest sewer outfall in the world and it is believed that the 300-foot maximum depth will represent the deepest subaqueous pipeline ever constructed.

This project is a key feature in the \$60,000,000 Hyperion Sewerage Expansion Program now being undertaken by the City of Los Angeles in an effort to meet its unprecedented growth. Hyperion Engineers, a joint venture, comprised of the Los Angeles engineering firms of Holmes & Narver, Inc.; Daniel, Mann, Johnson and Mendenhall; and Koebig & Koebig; have been retained by the City to prepare plans and specifications for portions of the project estimated to cost \$40,700,000. Features represented by this cost include conversion of a large portion of the Hyperion Sewerage Treatment Plant from the high rate activated sludge process to primary treatment and an increase in its capacity from 245 mgd to 420 mgd; an additional underground re-

lief outfall to carry the additional sewage; and two long submarine outfalls for the disposal of treated effluent and digested sludge.

**Ocean Disposal**—The choice of the ocean disposal for digested sludge was necessitated by the high cost of sludge processing and the low return from fertilizer sales. This problem is not unique with the City of Los Angeles. The East Bay Municipal Utility District in Oakland, California, and the Los Angeles County Sanitation Districts, as well as some eastern cities, have been disposing of digested sludge by dilution for some time. The present filter and drier equipment, representing an investment of about \$8,000,000, will be placed on a standby basis. Some experiments will be conducted in the future to determine the feasibility of producing high quality fertilizer from waste activated sludge.

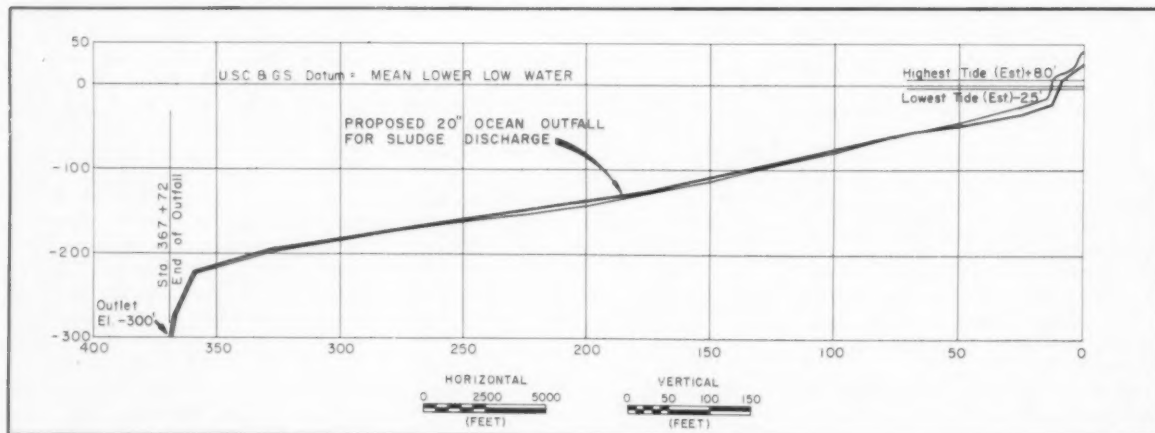
**Special Research**—In view of the unprecedented nature of the proposed project, Hyperion Engineers has carried out extensive research into the various problems involved. Installations in the United States where sludge pumping has been practiced on a large scale were checked and members of the project staff visited selected subaqueous installations on both coasts. The experience of the oil and gas industry

in constructing off-shore loading and gathering was also investigated.

In addition, special studies have been concurrently carried out to determine the ability of Santa Monica Bay to receive the average flow of 2.45 million gallons per day of digested sludge. A thorough oceanographic research program under the direction of the Allan Hancock Foundation of the University of Southern California has yielded much in the way of design information concerning the current and temperature patterns in the bay and also data on the behavior of the digested sludge. Dr. Norman H. Brooks of the California Institute of Technology was retained by Hyperion Engineers to conduct sedimentation tests to determine the settleability of the sludge.

**Plant Effluent Added**—In order to minimize clogging and sediment building up in the pipe, a flow of 5.5 mgd will always be maintained. This is accomplished automatically by adding reclaimed plant effluent to the flow of digested sludge so that the total quantity will be constant. The existing sludge pumping plant will be modified to incorporate two 8-inch centrifugal pumps, each of which will deliver 3000 gpm at a head of 50 feet.

**Submarine Pipeline**—The pipe line consists of 22-inch outside



● PROFILE of world's longest sewer outfall. Pipeline is part of \$40 million improvements to Los Angeles sewerage system.



diameter, 3/8-inch wall, high strength steel pipe, with a 1/2-inch cement mortar lining, and a coal-tar enamel and gunite coating. The heavy wall thickness of the 22-inch line, together with the gunite coating was provided in order to permit the line to have a slight negative buoyancy when empty. This is necessary to the type of construction which will allow the line to be pulled in place along the bottom after an initial makeup on shore. This method of construction has been used extensively for marine oil loading lines and for other oil and gas subaqueous pipelines. In order to protect the pipe from scour and wave forces in the near-shore region, the line will be buried out to a distance of 7000 feet off-shore.

**Coating**—The steel pipe is protected first with a triple wrap coating of coal-tar enamel reinforced with several layers of fiberglass and asbestos felt. This type of cover has been used in many subaqueous installations and has proved to be an excellent coating. A minimum thickness of 1 1/4 inches of reinforced gunite outer coating is then applied over the coal-tar to provide resistance from mechanical abrasion and additional weight. Since the underwater weight is so important to the construction operations, the contractor is planning special measures to limit water absorption into the coating. A one-half inch spun cement mortar lining protects the interior of the pipe.

**Cathodic Protection**—In order to provide additional protection to the steel pipeline, a complete cathodic protection system was designed and incorporated into the project. With an ample supply of low cost power available nearby at the Hyperion Plant, the rectifier system of cathodic protection was chosen, not only for the protection afforded the line, but also because with proper testing facilities it is possible continuously to monitor the condition of the coating. If underwater damage occurs to the pipeline, the testing system would permit the probable location of the area of damage. If the line installed has a coating resistance of 4 kilohms/sq. foot, (assumed conservatively) the coating will be subject to a maximum potential of about 1.0 volt and the total current requirement will be 22 amperes. Power is provided by a 440-volt, 50-amp rectifier mounted in the room of the treatment plant where it will be easily accessible. The current is impressed on the pipeline by an anode installation. The distance from the pipeline was

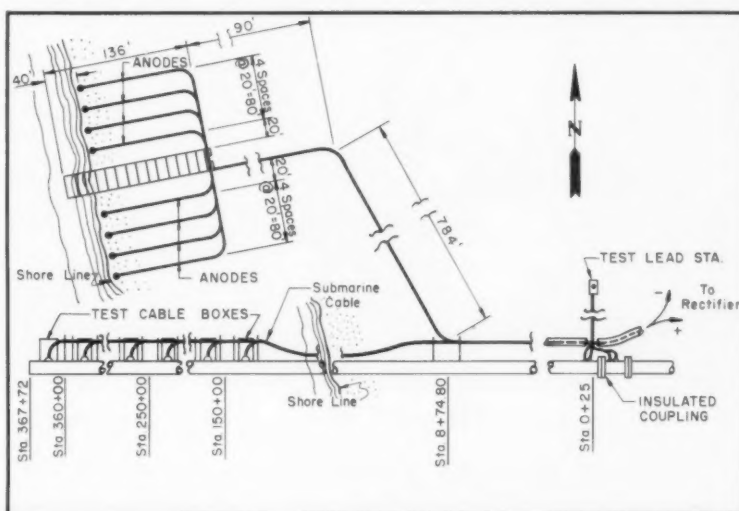
chosen to limit the potential applied so that the coating would not be damaged. The anodes consist of twenty 4-inch x 80-inch graphite rods buried below sea level at a 20-foot spacing.

Since the pipeline is so inaccessible from the sea end, the problem of testing the effectiveness of the cathodic protection becomes quite acute. It was finally decided to utilize multi-conductor submarine cable for the purpose. Pairs of conductors connect to test lead stations spaced along the pipe. The conductors terminate at a test station on shore where the potential difference between each test lead station and the shore can be determined.

**Hydrographic Surveys**—With the outfall extending almost seven miles off-shore, the problem of furnishing

**Bottom Investigations**—In order to ascertain the bottom conditions in the vicinity of the pipeline, engineers and geologists with skin diving equipment checked the line with water jet probes out to a depth of 150 feet. In the near-shore region where the pipe is to be buried, a portable drilling tower was set up and undisturbed samples were taken at several stations. The portion of the line seaward of 150-foot depth was tested by plunging weighted coring tubes into the bottom from the survey ship. Bottom sediment samples were obtained with a snapper.

**Project Costs**—Unit prices for the principal various items of work, as bid by the Healy-Tibbitts Construction Co., San Francisco are: Furnishing 22-in. OD steel pipe with



● SYSTEM detailed above gives cathodic protection to the pipeline. Special test facilities permit continuous monitoring of condition of coating of the submerged pipe.

accurate control for the hydrographic surveys assumed major proportions. Besides the long distances involved, the poor atmospheric conditions in the Los Angeles Basin contributed to the difficulties. The solution finally worked out was to lay out two first-order triangulation stations on two tall buildings on-shore and, by using Wild T-3 theodolites and working at night, it was found that satisfactory control was obtainable. The hydrographic boat was equipped with survey echo sounder which could read the depths to an accuracy of one-half of one percent. The boat and the shore control stations were equipped with two-way radio communication. Profiles of the bottom were developed from the echo sounder traces which were taken along the several alternate lines under consideration.

3/8-in. wall with coal tar and gunite coating and cement mortar lining, 36,750 ft., \$25.00 per ft.; installing on-shore section, including excavation and backfill, 1078 ft., \$15.00 per ft.; trench excavation, off-shore, including backfill, 4300 cu. yds., \$50.00 per yd.; installing 22-in. off-shore line, 35,672 ft., \$34.50 per ft.

**Personnel** — Hyperion engineers personnel assigned to this project are D. L. Narver, Jr., project manager; E. H. Graham, Jr., assistant project manager; R. R. Alloy, project engineer; and the author as assistant project engineer. Among consultants in the project are Fred Bowlus, Norman Brooks, Harry Keeling and Richard Tibby. Lyall Pardee, City Engineer of Los Angeles, and Norman Hume, Los Angeles Bureau of Sanitation, have been closely associated with the project.



## Set your sights on an Allis-Chalmers HD-6G



**"Our new HD-6G saves man-hours  
and speeds road construction."**

*Clyde Kilpatrick, Supervisor  
District 2, Newton County, Mississippi*

**Versatility counts on county jobs.** And in Newton County they're proving it with a new HD-6G tractor shovel. In its first two months on the job, the 6G dug pipe-line ditches, laid concrete pipe, cleared right-of-way and cut drainage ditches. The 6G also loaded sand and gravel on a State Aid road project.

On this job, it loaded a truck every three minutes, nine hours a day. No wonder Supervisor Kilpatrick says: "Our HD-6G does everything more specialized equipment can do." With its 1½-yd bucket and many interchangeable attachments,

it stays busy—and busy equipment stretches budget dollars. And—as Mr. Kilpatrick says: "We're always sure of good service from our Allis-Chalmers dealer."

Yes, cost-conscious counties and townships get their budget's worth from the useful HD-6G. When you want equipment to lend a hand on out-of-the-ordinary jobs, you can count on the 6G. And here's why—the HD-6G represents the *most* advanced engineering in the tractor shovel business—not just in features but in *basic* design. That means

plenty of *power*, superior *balance*, extra *strength* in all components, *weight* in the working parts and big safety factors . . . plus many exclusive on-the-job advantages important to owners and operators.

HD-6G tractor shovels are working in your area now. Check your Allis-Chalmers construction machinery dealer on where you can see one in action. And remember, your dealer is headquarters for factory-trained servicemen, factory-approved facilities and complete stocks of True Original Parts to keep your equipment operating right. See him soon.

**HD-6G**  
1½-yd bucket  
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19,600 lb

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

# ALLIS-CHALMERS





# NEWS BULLETINS

AMERICAN PUBLIC WORKS ASSOCIATION, 1313 EAST 60th STREET, CHICAGO 37, ILLINOIS

## Anderson Elected to Head New Slate of APWA Officers

Fort Worth, Texas—One of the highlights of the annual business meeting of the American Public Works Association, which was held in Fort Worth, on Monday, September 24, was the announcement of the election returns, which places Robert Anderson, Superintendent of Public Works and Village Engineer of Winnetka, Illinois at the head of this important organization. The new president succeeds Edward P. Decher, Secretary of the Joint Sewer Commission of Newark, N. J. Mr. Anderson became a member of the Association in 1935 and has held many posts, including that of Treasurer and Vice President of the Central Area. He is a past-president of the Chicago Metropolitan Chapter, and has served on numerous committees of the APWA.



Mr. Anderson

This was the first election under the Association's newly revised constitution which provides for only one, rather than four vice-presidents, and for the election of nine regional directors. The Board of Directors, which is the governing body of the Association, consists of these duly elected officers plus the immediate past-president.

The new vice-president is Sol Ellenson, Director of Public Works of Newport News, Va., who became a member of the Association in 1941 and has been a long-time member of the Board of Directors. Members elected to serve three-year terms as

regional directors are: Albert G. Wyler, Director of Streets, New Orleans, La.; Wm. D. Hurst, City Engineer, Winnipeg, Manitoba, Canada; and Frederick Crane, General Manager, Buffalo (N. Y.) Sewer Authority. Those elected for two-year terms are: Jean L. Vincenz, Director of Public Works, San Diego County, California; Leo Flotron, Chief Highway Engineer, Dayton, Ohio; and Roy W. McLeese, City Engineer, Salt Lake City, Utah. Members elected to serve one-year terms as Regional Directors are: K. K. King, Director of Public Works, Phoenix, Arizona; Charles Cooke, Director, Park River Flood Control District, Hartford, Conn.; and R. V. Moschell, City Engineer, Alcoa, Tenn.

## Rogus Named Recipient of 1956 Nichols Award

Fort Worth, Texas—Casimir Rogus, Director of Engineering for the New York City Department of Sanitation was honored at the 62nd annual meeting of the American Public Works Association, at Fort Worth, Texas, last month, by his selection as the recipient of the 1956 Charles Walter Nichols Award. The award, consisting of an attractive certificate and a \$500 honorarium, was presented to Mr. Rogus by Warren A. Coolidge of Nashville, Tenn., a past president of the Association and member of the Awards Committee, for his leadership in the field of municipal sanitation, resourceful developments in the design and operation of sewage treatment facilities and application of sound engineering principles in the design of refuse disposal facilities for the world's largest city. Mr. Rogus has long been recognized as

an outstanding authority in his field and is now serving as Chairman of the Association's Refuse Disposal Committee.

## Oklahoma University Student Wins \$1000 ENR Fellowship

Fort Worth, Texas—The 1956 Engineering News-Record Fellowship for advanced study in the field of public works engineering and administration was presented to Dan Blankenship at the annual banquet of the American Public Works Association at the Texas Hotel in Fort Worth on Wednesday, September 26th. He is a senior engineering student at the University of Oklahoma and his home is in Corona Del Mar, California.

The citation accompanying the \$1,000 Fellowship stated that the award was presented in recognition of his demonstrated technical abilities, on-the-job performance while employed during the summer of 1955 in the public works department of Midland, Texas, his desire and scholastic capacity for graduate study and personal qualities particularly fitting for a career in the public service.

The award was presented to Mr. Blankenship by Stanley C. Palmer, City Engineer of Kansas City, Missouri, who was Chairman of the Association's 1956 Fellowship Committee.

## Fred Paul Receives Honorary Membership

Fort Worth, Texas—The membership of the American Public Works Association bestowed its highest honor on Mr. Frederick Paul, of Minneapolis, Minn. at its annual meeting in Fort Worth, Texas, last

OFFICERS: Robert Anderson, Winnetka, Ill., President; Sol Ellenson, Newport News, Virginia, Vice President. REGIONAL DIRECTORS: (three year terms) Albert G. Wyler, New Orleans, La.; Wm. D. Hurst, Winnipeg, Manitoba, Canada; Frederick Crane, Buffalo, N. Y.; (two year terms) Jean L. Vincenz, San Diego, Calif.; Leo Flotron, Dayton, Ohio; Roy W. McLeese, Salt Lake City, Utah; (one year terms) K. K. King, Phoenix, Arizona; Charles W. Cooke, Hartford, Conn.; R. V. Moschell, Alcoa, Tennessee. Immediate Past President, Edward P. Decher, Newark, N. J. Donald F. Herrick, Executive Director.



month, when it elected him an honorary member of the Association.

From a struggling beginning in a sod shanty near a Sioux Indian Reservation, not far from Watertown, South Dakota, he rose to become one of the most highly respected public servants in the nation. He was continuously employed by the City of Minneapolis from 1908 until his retirement at the age of 65 in 1948. Mr. Paul served in many capacities and was City Engineer from 1933 to 1948. He has continued his public service career even after his retirement, by serving as a consultant on the design and construc-

tion of the Minneapolis Metropolitan Sports Stadium, and first as Field Engineer and now as a member of the Minneapolis-St. Paul Metropolitan Airports Commission.

Mr. Paul received his civil engineering degree from the University of Minnesota and was a charter member of the Tau Beta Pi honorary fraternity. He was married in 1912, has one daughter and one son, and is active in many church and civic groups, and professional and social societies. He became a member of the American Public Works Association in 1930, and served as its president in 1942.

## Thirty-Five Members Receive Samuel Greeley Service Award

Fort Worth, Texas—The Samuel A. Greeley Service Award was presented to thirty-five members of the American Public Works Association at its annual banquet in Fort Worth, Texas, at the close of the 1956 Public Works Congress and Equipment Show. The Award was established in 1930 by Mr. Greeley, of the consulting engineering firm of Greeley and Hansen of Chicago, and is presented to those men who have completed thirty or more years of service with a single municipality. They must also be members of the APWA for a minimum of five years.

This year awards were presented to the following members by John S. Flockhart of Newark, New Jersey, Chairman of the Awards Committee.

William W. Griffin, Deputy Commissioner of Streets, (In Charge of Sanitation), Philadelphia, Pa.; R. N. Allred, Supt. of Motor Transport, Columbus, Ga.; Frank A. Atwill, Supervising Civil Engineer, Street & Engineering Dept., Oakland, Calif.; John R. Baylis, Engineer of Water Purification, Dept. of Water & Sewers, Chicago, Ill.; George S. Burnett, City Engineer, Revere, Mass.; Chalkley Du Val, Assistant Director, Dept. of Public Works, Richmond, Va.; E. L. Pettingill, City Engineer (recently retired), Mt. Clemens, Mich.; Lloyd D. Knapp, Commissioner of Public Works, Milwaukee, Wisc.; Albert Wyler, Director of Streets, New Orleans, La.; Warren Schneider, Director, Bureau of Sanitation, Dept. of Public Works, Los Angeles, Calif.; Olof F. Anderson, County Surveyor and Road Commissioner, Alameda County, Calif.; Harry R. Stiedemann, Supt. of Municipal Equipment, Milwaukee, Wisc.; Leonard C. Bailey, City Engineer (recently retired), Knoxville, Tenn.; T. E. Maxson, Assistant City Engineer, Memphis, Tenn.; W. J. Long, County Engineer, Muscogee County, Ga.; E. E. Crowell, Town Secretary, Highland Park, Texas; Howard L. Lilley, City Engineer, Dearborn, Mich.; Carl A. Distelhorst, Engineer-In-Charge, Street Constr. Div., Dept. of Public Works, Milwaukee, Wisc.; Charles W. Horlacher, Assistant to the City Manager, Dayton, Ohio; H. A. Knudsen, Manager, Sewage Disposal Div., East Bay Municipal Utility District, Oakland, Calif.; Louis Severson, Supt., Constr., Maint. & Repair, Dept. of Public Works, Rochester, N. Y.; C. Elmer Carter, Supt. of

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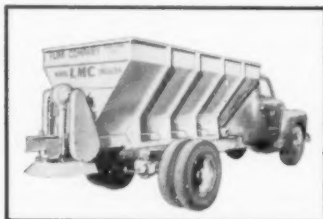
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Public Works, Petoskey, Mich.; T. M. Etheridge, Supt. of Sanitation, Columbus, Ga.; Elmer P. Fuller, Civil Engineer, Irvington, N. J.; Roy F. Goodspeed, Director of Public Works, Ferndale, Mich.; Lester C. Hollis, Supt. of Public Works, Needham, Mass.; Howard S. Kaulbach, Street Maint. Engineer, Dept. of Streets, Oakland, Calif.; Charles N. Longhurst, Civil Engineer, Dept. of Public Works, Nashville, Tenn.; J. Haines Shertzer, City Engineer, Lancaster, Pa.; John B. Smith, Supt. of Public Works, Glen Rock, N. J.; Floyd D. Terrill, Supt. of Streets, Hutchinson, Kansas; Wil-

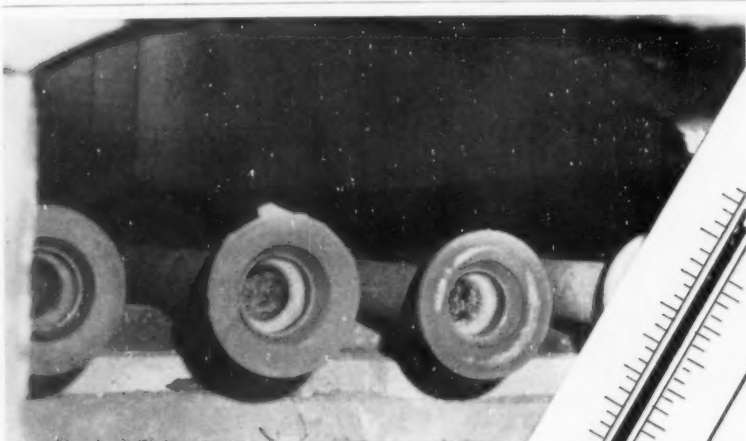
liam Knourek, Ward Supt., Chicago, Ill.; Albert W. Konefes, Supt., Bureau of Equipment Service, Dept. of Streets & Sanitation, Chicago, Ill.; Roderick W. Mason, Sanitation Foreman, Dept. of Streets & Sanitation, Chicago, Ill.; and George L. Oppen, Village Mgr., Riverside, Ill.

#### Over 400 Attend NY-NJ Metropolitan Chapter Meeting

East Orange, N. J.—An outstanding chapter meeting was held by the New York-New Jersey Metropolitan Chapter on September 12, 1956, when the City of East Orange

played host to more than 400 municipal officials and others interested in public works activities. An able committee headed by Arthur Brokaw, City Engineer of East Orange as meeting chairman, arranged a diversified program which featured equipment exhibits, a technical session, special tours, a luncheon, cocktail party, dinner and business meeting.

Registration was held at the East Orange Armory, where forty-six displays exhibited equipment, materials and services for the public works field. Organizations and manufacturers with exhibit space were: N. P. Nelson Iron Works; Dale & Rankin; Tyler-Preusser; Walton Equipment Co.; R. E. Brooks Company; North Jersey Equipment Co.; G. C. Gilbert Inc.; E. H. Kliebenstein Company; White Motors Company; Ehrbar Equipment Company; Dianem Company (Gar Wood); Smith Tractor & Equipment Co.; Industrial Hardware Company; Campbell Foundry; Lock Joint Pipe Company; A. P. Smith Company; Johnston & Dealaman; Heil Products; United Tractor; Matcha Machinery Company; Parking Meter Company of N. J.; Multiplex Concrete Company; Flexible Pipe Tool Company; Elgin Sweeper Company; Mack Truck Company; Bergen Building Block Company; Equipment Distributing Company; Tuffibre Company; Sika Chemical Company; N. J. Bell Telephone Company; H. J. Zoubek Company; Aeroil Company; The Rodgers Company; Motorola Company; Diamond T Motor Company; Tassco Company; Atlas Crane Company; Garden State Parkway; International Salt Company; Gullick Henderson; Evalal Company, Inc.; Chas. Schaffer Company; Jersey Testing Laboratory; The Cummings Company; The Sanitation Company; and the Homelite Company. Carl Vogt, Superintendent of Streets for East Orange was in charge of the exhibits. Following an inspection of equipment exhibits, chapter members and their friends, were treated to an elaborate buffet luncheon sponsored by the New Jersey Equipment Dealers' Association; the Heil Company; A. P. Smith Manufacturing Company; Parking Meter Company of New Jersey; Lock Joint Pipe Company; Motorola Communications & Electronics Div.; Dianem Company; Pfaff & Kendall Company; and the host City of East Orange. After lunch the group was welcomed by the Hon. William M. McConnell, Mayor of East Orange.



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METERS  
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CONTROLS

Next on the program was a technical session. This featured a panel discussion on snow and ice control with Paul R. Screvane, Director of Operations, New York City Department of Sanitation, as moderator, and Curtis C. Colwell, County Engineer, Essex County, New Jersey and August Zentgraf, Division Engineer, Division of Sanitation, Newark, New Jersey as speakers, followed by a paper entitled "The Story of the East Orange Water Supply" by Charles G. Bourgin, Water Engineer and Manager of the East Orange Water Works.

Two tours were made by special

busses during the afternoon. One of these visited the offices and shops of many municipal activities at the City Hall buildings and city garages, and showed the visitors some of the municipal parking lots, schools and the Garden State Parkway. This tour included a demonstration of the latest in tree felling techniques under the direction of Harry Turner, City Forester. On the other tour a trip was made through the city and the East Orange Water Reserve.

Special entertainment in the form of a cocktail party was sponsored by the Campbell Foundry Com-

pany before the dinner and business meeting. Details of the latter are reported in the following item.

### Fredericks Named to Head NY-NJ Metropolitan Chapter

East Orange, N. J.—At the annual business meeting of the New York-New Jersey Metropolitan Chapter, Harold Fredericks, Town Engineer, Irvington, N. J., was elected President of the chapter for the coming year, to succeed Francis J. Klaess, Superintendent of Public Works, Rockville Centre, N. Y. The slate of officers include Casimir Rogus, Director of Engineering, Department of Sanitation, New York City, Vice President; William S. Foster, Engineering Editor, "The American City," Secretary; and John J. Baffa, Consulting Engineer, New York City, treasurer; with August Zentgraf, Division Engineer, Division of Sanitation, Newark, N. J. and Floyd F. Wilcox, Commissioner of Public Works, Lynbrook, N. Y. as Directors. A special event at the meeting was the presentation of the chapter's award of Merit to Paul R. Screvane, Director of Operations, Department of Sanitation, New York City, for his outstanding contributions to the chapter and to the public works field.

• • •

### Garden State Parkway Revenue

The Garden State Parkway broke all revenue records in July with a net toll income of more than \$1.75 million dollars, the New Jersey Highway Authority reports. July's revenue not only topped the previous record income of July, 1955, but also twice eclipsed the long-standing weekend high of August 5-6-7 last year. The all-time weekend toll record was set July 27-28-29, 1956 at approximately \$205,000. In addition to the record toll collection, more than \$50,000 was earned by the Parkway in July on its concessions.

### Use of Plastic Pipe by Water Departments

In a questionnaire sent recently to Water Department Engineers and Superintendents by Public Works Magazine, the question was asked: "Have you used plastic pipe." There were 1,109 returns; 117 replied that they had used plastic pipe; 849 said they had not used it; and 143 did not answer the question. Of the 117 using plastic pipe, four said they did not like it; 10 used it for services only; and 10 had used it "a little" or experimentally.

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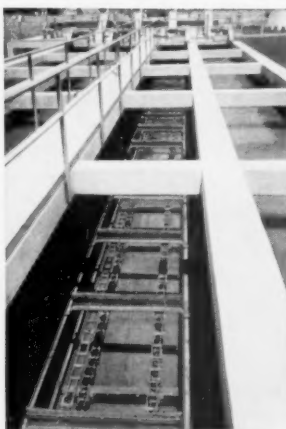
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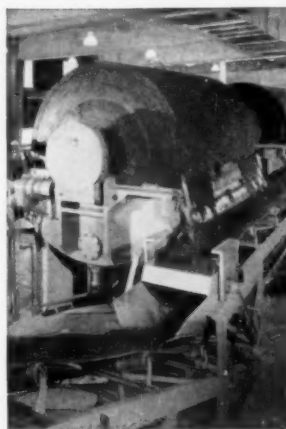




**PRE-AERATION** increases efficiency of 20 tanks equipped with sludge collectors. Air floats grease, flocculates solids and adds dissolved oxygen to the effluent.

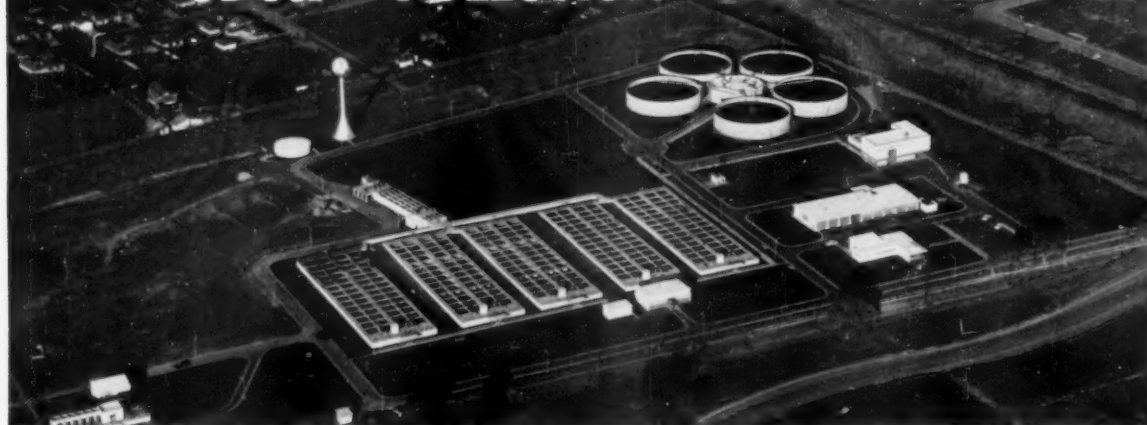


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## PUBLIC WORKS DIGESTS

# THE SEWERAGE AND REFUSE DIGEST

### Measuring Filterability Of Sewage Sludges

For measuring and comparing the filterability of sewage sludges it is desirable to have a parameter which is as independent as possible of variables, such as the initial solids content of the sludge, volume of sludge filtered, area of filtering surface, and pressure at which the filtration is carried out. After investigating various theories of filtration applicable to sewage sludges, the authors decided that Carman's theory appeared to be the most appropriate one to use; that this and the concept of specific resistance adequately describe the results of filtration experiments, and specific resistance is a suitable parameter to use in comparing the efficiency of different prefiltration treatments and coagulants, and for research purposes.

"Vacuum Sludge Filtration: Interpretation of Results by the Concept of Specific Resistance." By P. Coackley, of Durham University, and B. R. S. Jones, of the Univ. of London, England. *Sewage and Industrial Wastes*, August.

### Oxidation in Biological Sludges

Sludge accumulated in bio-oxidation systems will undergo oxidation at varying rates depending upon the factors of temperature, waste characteristics, microbial content, and sludge age. The oxidation rate approximately doubles for each 10° rise in temperature. The microbial content of sludges will vary widely depending upon the nature of the wastes being treated. For example, while dairy and cannery wastes are composed almost entirely of microorganisms, sludges from pulp and paper mill waste oxidation may vary from 50 to 75% microbial content. The oxidation rate approximates monomolecular kinetics during the early phases of the oxidation process. With increasing times of aeration, the rate progressively decreases and approaches a limit of

about 40 to 60% volatile solids reduction. The remaining constituents are resistant to further oxidation and provide a residue for disposal. By comparison, most anaerobic processes provide a reduction in volatile content of about 60%. The quantity of accumulated sludge and the oxidation rate are a function of the sludge age in the bio-oxidation process, since a portion of the sludge synthesized from BOD removal is oxidized in the aeration system of the plant.

Sludge disposal by oxidation has been employed in dairy waste treatment, and in most cases the residue is non-putrescible and produces no odors. Pressure flotation can be employed for sludge thickening; concentrations of 2 to 3% on a dry weight basis have been attained by it. Nutrient chemical recovery, by recycling the nitrogen-rich liquor after oxidation may be advantageous in systems requiring supplementary nutrient addition.

"Studies on the Oxidation Kinetics of Biological Sludges." By W. Wesley Eckenfelder, Jr., Ass't Prof. of C. E., Manhattan College. *Sewage and Industrial Wastes*, August.

### Sewer Infiltration—Exfiltration Ratios

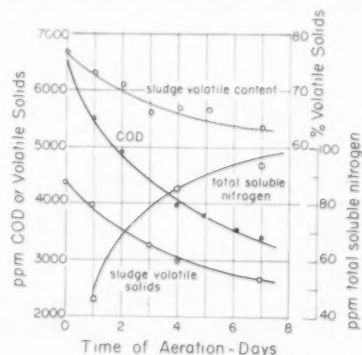
Recent findings in two independent laboratory tests on infiltrated water in sewer lines have provided new

help to engineers in evaluating testing data. In 1940, H. F. Lundberg determined that lines checked for infiltration and found perfectly dry will show by an exfiltration test 25 to 50 percent of the allowable leakage of 10,000 gallons per mile per 24 hours. Through joint efforts of the Clay Sewer Pipe Association and the National Clay Pipe Manufacturers, Inc., tests have been conducted which show the correlation between exfiltration and infiltration; that exfiltration always exceeded infiltration; and that the percentage in excess varied with the pressure applied, from 4.8% at 0.87 psi to 24.4% at 3.47 psi. These results were verified by the Smith-Emery Testing Laboratory in an independent investigation.

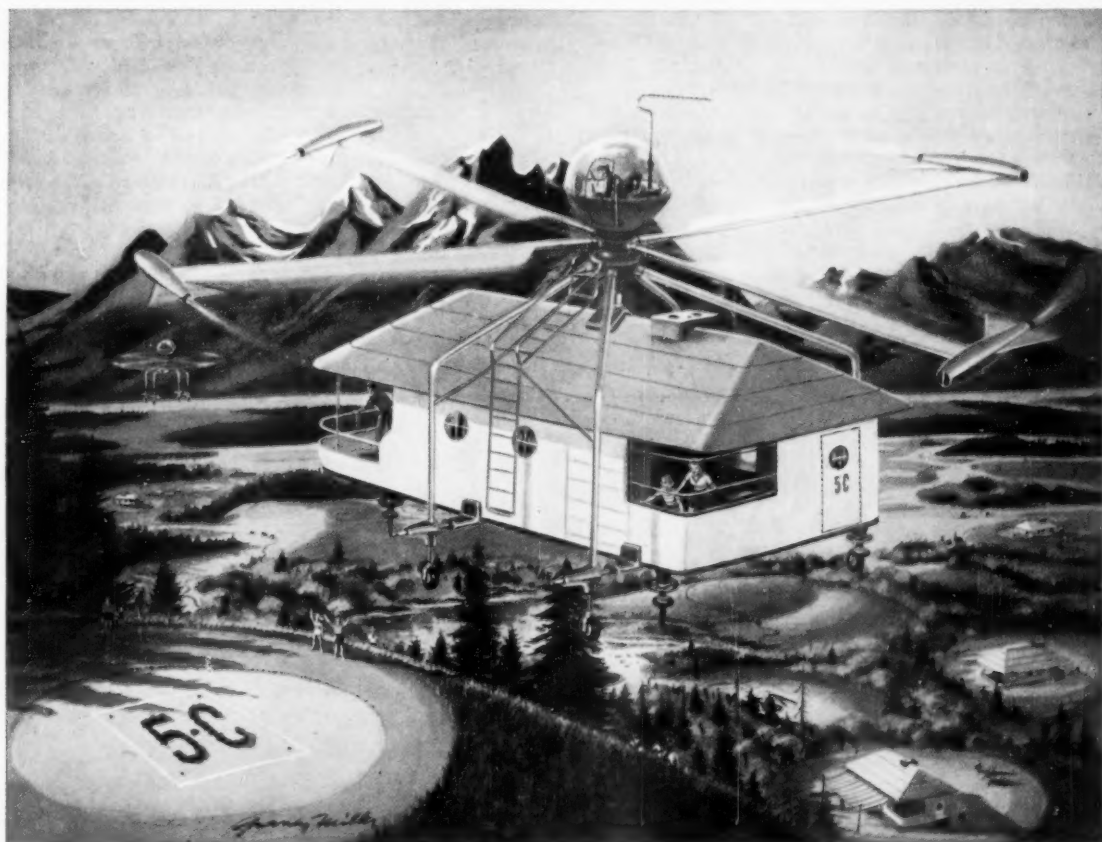
"New Data on Sewer Infiltration-Exfiltration Ratios." By Sherwood Borland, Chief Engineer, Clay Sewer Pipe Association, Inc., *PUBLIC WORKS*, September.

### Study of a Two-Stage Trickling Filter

This study was made of a filter plant serving the A & M College of Texas, dosed with settled sewage. There were eight filters, four used as primary or roughing filters, the other four receiving the primary effluents without intermediate sedimentation. Conclusions reached were that, within the loading range of 1,000 to 4,000 lb. of 5-day BOD per acre-foot per day applied to the primary filters, the BOD removal increased from 636 to 1426 lb. per acre-foot at 3,000 lb. loading, but dropped to 1130 lb. at 4,000 lb. loading, the percent removal decreasing consistently from 63.6 to 28.7, resulting in a poorer quality of effluent ranging from 59 to 116 ppm BOD. The suspended solids removal increased from 523 to 1348 lb. per day at loadings ranging from 814 to 3207 lb. per acre-foot per day, considered to be unsatisfactory for discharge. These filters produced flocculation of organic solids and some biochemical oxidation. The relation between the BOD applied and the



● TRENDS in endogenous respiration of domestic sewage activated sludges.



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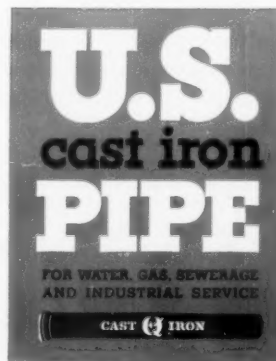
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*PUBLIC WORKS for October, 1956*



removal is hyperbolic in nature. Intermediate sedimentation in series filtration did not seem to be necessary, since no abnormal sludge was obtained. No nitrification occurred in the primary filters, but in the secondary filters nitrification occurred at a decreasing rate up to loadings of 3100 lb. of BOD, when it ceased altogether. At the loadings stated, series filtration afforded a higher degree of treatment than single-stage filtration, even at a higher hydraulic rate.

"Two-Stage Trickling Filter Performance." By J. H. Sorrels and

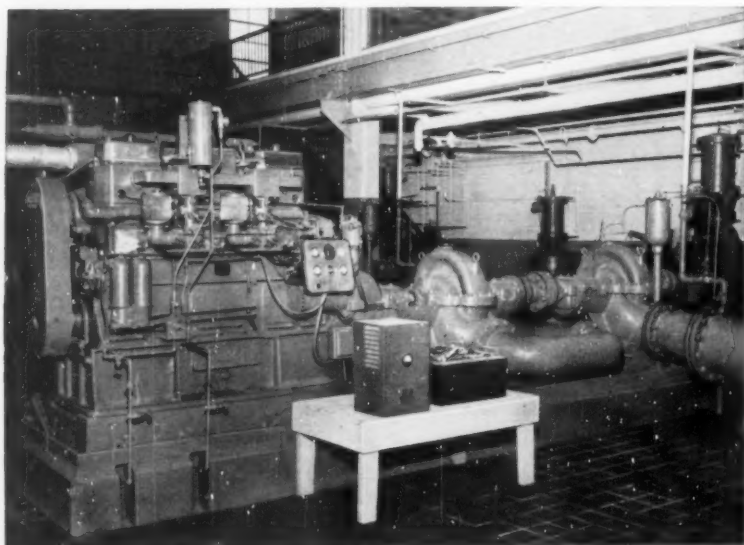
P. J. A. Zeller, Research Engineers, Texas Eng. Experiment Station. *Sewage and Industrial Wastes*, August.

#### Sanitary Landfill At Dallas, Texas

Dallas adopted sanitary landfill 14 years ago and now collects refuse from approximately 500,000 population and disposes of it on five fills located within easy hauling distances around the perimeter of the city. As a rule, the lands for the

fills are leased from the owners and returned on completion. In the past, they have been utilized for parks, playgrounds, housing developments, commercial uses, agriculture and other purposes. The dumps are carefully policed to insure that they do not become nuisances from odors, rats, flies or burning or blowing refuse. The present five landfill areas receive approximately 26,000 tons a month of city-collected refuse and 14,000 tons collected by commercial haulers. Controlled burning of combustible refuse is permitted in certain sections where it will not create a nuisance. Licensed scavengers are authorized to pick the dumps for salvageable materials. It has been found that the heavier the equipment used for compaction, the better the fill; crawler tractors and bull-clams are used. Refuse is compacted in layers rarely more than 4 ft. deep and covered daily with 4 in. of earth. Settlement is generally slightly more than 10%. Depths of completed fill reach 20 to 25 ft. Disposal cost of refuse at the fills runs approximately 39 cts. a ton, including cost of dump supervision, equipment and equipment operators.

"Perimeter Sanitary Landfill for Dallas Refuse Disposal." By G. C. Brinkley, Supt. of Sanitation. *PUBLIC WORKS*, September.



#### CLIMAX POWER IN NORTH CAROLINA

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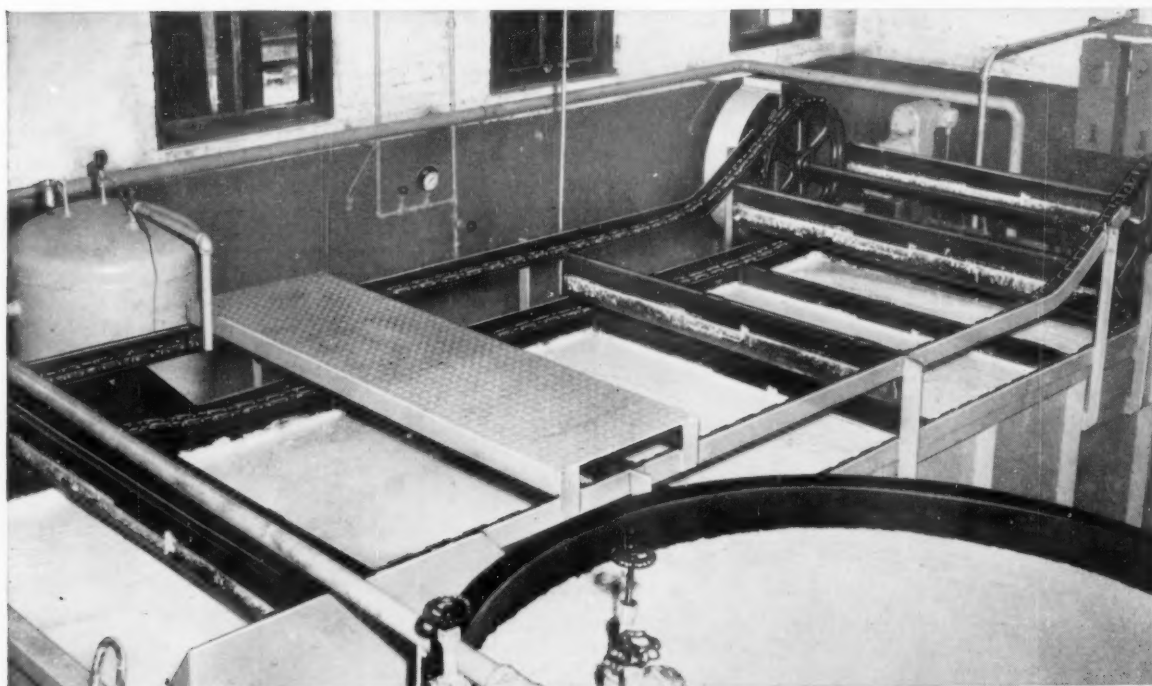
#### Enumerating Tubercle Bacilli

In studying the survival of tubercle bacilli in sewage and other polluted waters, the investigators found it necessary first to find some for detecting the pathogen. Two methods were tried, animal inoculation and cultural. The former gives positive identification but not quantitative results. An effort was made to find some method for suppressing the saprophytes (which, in sewage, far outnumber tuberculosis organisms) without materially affecting the pathogen, either by use of antibiotics incorporated in the culture medium; or by pretreatment of the sample by controlled chlorination; or by pretreatment of the sample with Bradosol, a quaternary ammonium compound. The criterion of success was the complete suppression of the saprophytes with an effect on the recovery of tuberculosis organisms such that the presence of the pathogen could be detected in 1 ml of the original sample. These criteria were not met by use of penicillin, grisein, or terramycin. Chlorination gave substantial but not complete sup-





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### To recover materials—eliminate pollution—clarify water for re-use

For industrial waste treatment...in oil refineries, tanneries, meat packing and food processing plants, chemical plants and many other places, Rex Float-Treat offers a proven way of recovering oils, fats, grease and other materials, clarifies process water and liquids for re-use, and reduces pollution.

Rex Float-Treat eliminates the pumping of raw influent liquids so breakup of delicate, light solids... the emulsification of valuable fats and oils... is avoided. Because only recycle is pumped, operat-

ing costs are substantially reduced.

Float-Treat is available as a completely packaged unit in a metal tank or can be furnished for concrete tank installation.

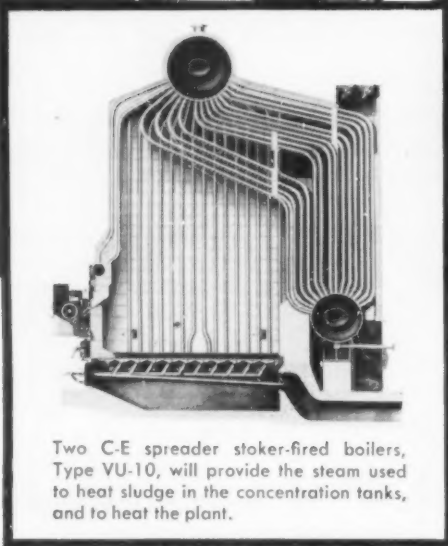
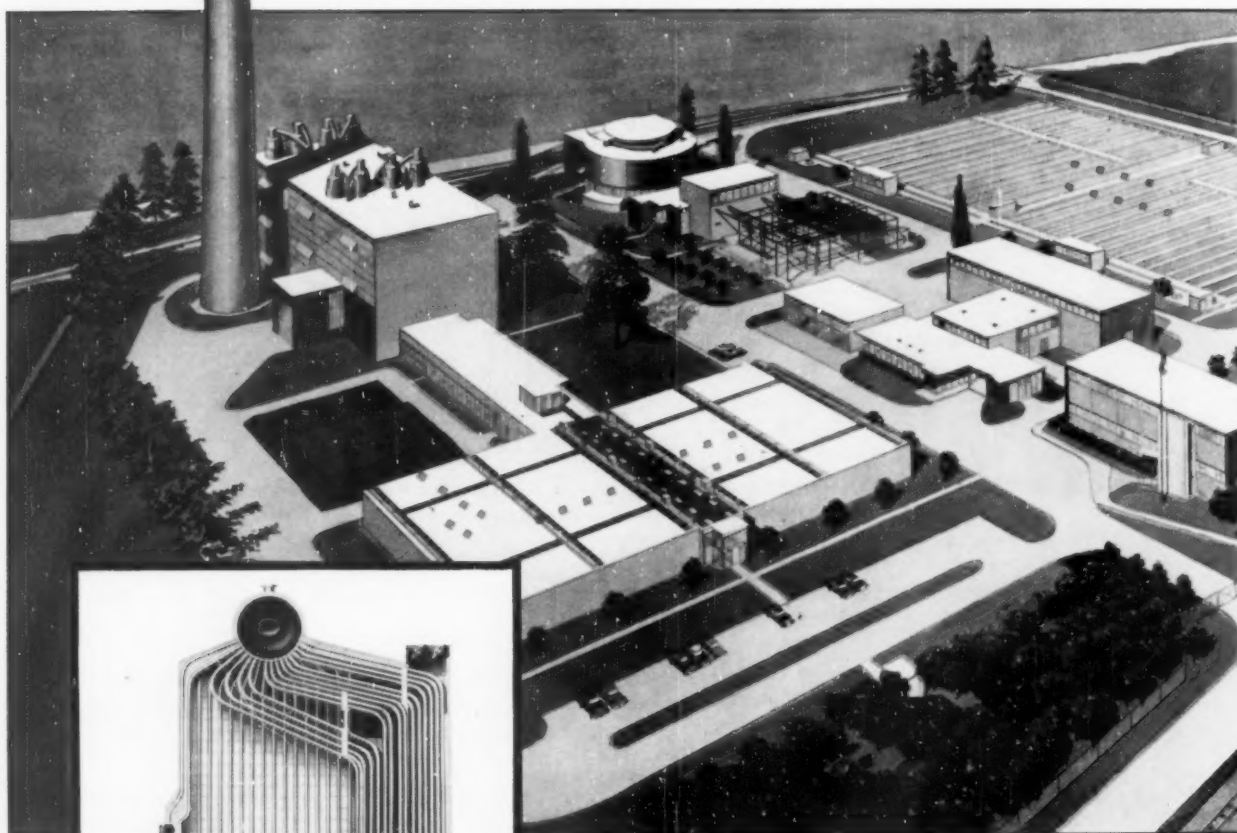
Rex Float-Treat is only one method of treating industrial and municipal wastes. Equipment is also available for screening, settling and grit removal. Get all the facts, today! Write CHAIN Belt Company, 4722 West Greenfield Avenue, Milwaukee 1, Wisconsin.

**CHAIN BELT COMPANY**  
MILWAUKEE 1, WISCONSIN

# Pittsburgh selects for sewage

Pittsburgh's projected one-hundred-million-dollar sewage treatment system will serve a total of seventy communities having an equivalent population of 1,500,000. More than sixty-three miles of new sewers will be laid to feed raw sewage to the hub of the system — the seventeen-million-dollar treatment plant to be located at Woods Run in the City of Pittsburgh.

Four C-E Raymond Flash Drying and Incineration Units will comprise the sludge disposal system at this plant. Each unit will be capable of handling over 300 tons of concentrated sludge per day.



Two C-E spreader stoker-fired boilers, Type VU-10, will provide the steam used to heat sludge in the concentration tanks, and to heat the plant.

The Pittsburgh Disposal Plant  
J. F. Laboon, Executive Director and Chief Engineer  
Metcalf and Eddy, Consulting Engineers

Incoming sewage will be pumped to the screens and aerated grit chambers and thence flow to the preaeration and settling tanks at far right. The solids will be pumped to the sludge concentration tanks (left foreground) where they will remain for five days. From there the sludge will be pumped to the incinerator building (left background) where it will be dried and burned. The incinerator building will also contain the two C-E boilers.

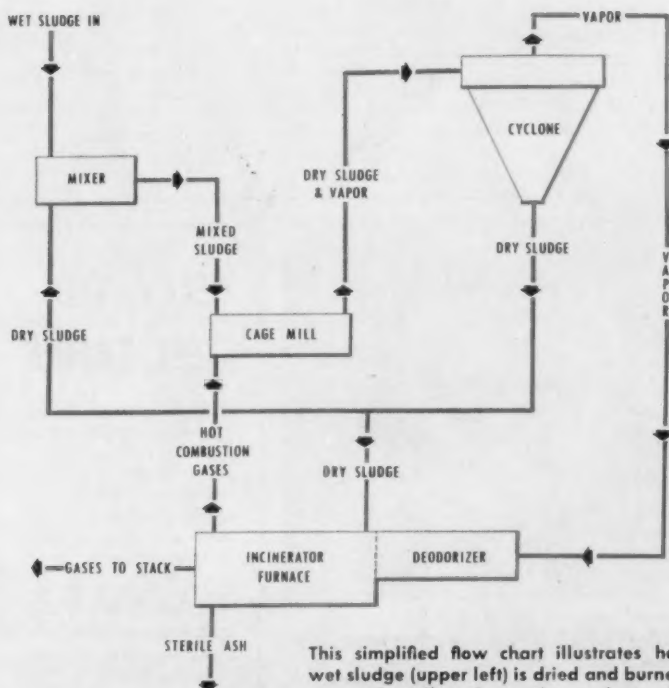
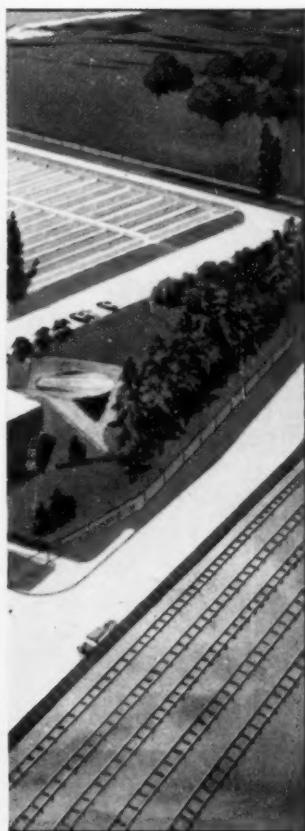
# C-E Raymond

## sludge incineration

The sludge will have a moisture content of 82% and each C-E Flash Drying and Incineration Unit will be capable of burning more than 55 tons of dry solids per day while evaporating more than 250 tons of water. Each C-E Raymond Unit will be equipped with a Deodorizing System which will free the moisture-laden combustion gases of objectionable odors. In addition, each of the four incineration systems will incorporate equipment for the control of fly ash.

Throughout the country, the C-E Raymond Flash Drying and Incineration System is achieving an ever-wider measure of popularity. In fact, *more filter cake is dried and/or burned by the C-E Raymond System than by all other systems combined.*

If you are considering new sewage treatment facilities, investigate *the modern method* of sludge disposal. C-E Raymond specialists will be happy to work with you and with your consultants. No obligation, of course.



This simplified flow chart illustrates how incoming wet sludge (upper left) is dried and burned. Odor-free gas and sterile ash are the products of the system.

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ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WASTE DISPOSAL

PUBLIC WORKS for October, 1956

151

pression of sewage saprophytes and 50% recovery of the tuberculosis organisms. Pretreatment of the sample with 500 ppm of Bradosol for 20 min. gave a complete suppression of sewage saprophytes and a 70 to 80% recovery of the tubercle bacilli.

"Enumeration and Survival of Human Tubercle Bacilli in Polluted Waters." By H. Heukelekian and M. Albanese, of the N. J. Agricultural Experiment Sta. *Sewage and Industrial Wastes*, August.

#### Plant Design To Permit Expansion

The present Detroit sewage treatment plant, opened in 1940, was designed to serve a population of 2.4 million, but the design incorporated ideas to permit sufficient expansion to accommodate 4 million. In 16 years the sewage load increased from 400 mgd. to 500 mgd. Expansion provisions permitted the installation of 300 mgd. additional pumping capacity in space available. Similarly, two new bar racks, two pairs of grit collectors, two sedimentation tanks and four Conkey vacuum sludge filters were added to complete the expansion in available space. The new filters

utilize a water spray to clean the filter cloth in the dead, or no-vacuum, area without interruption of drum rotation.

"How Design of a Sewage Treatment Plant Reduced Expansion Problems." *PUBLIC WORKS*, September.

#### Other Articles

"Refuse Disposal Plant Modernization" at Columbus, Ohio. Incinerators modernized and garbage ground. By Henry R. Patterson, Asst. Director, Dept. of Pub. Serv. *Public Works*, September.

"Tennessee's First Major Sewage Treatment Plant" at Knoxville. By J. W. Whisman, Eng. of Sewage Disposal System. *American City*, August.

"New £900,000 Sewage Treatment Scheme at Peterborough," *England*. The Surveyor, July 21.

"County Refuse Collection and Disposal Fills Need and Makes Money." Franklin Co., Ohio, using land fill, charging for services and raising the necessary funds for equipment by sale of revenue bonds, serves all of the county outside of the city of Columbus. By Desso T. Mitchell, County San. Eng. *Public Works*, September.

"Emergency and Disaster Planning for Water and Sewerage." Suggestions of Dept. of Commerce. *Public Works*, September.

"Sewage Works Practices: Activated Sludge." By Don E. Bloodgood, Prof. of San. Eng., Purdue Univ. *Water & Sewage Works*, August.

"Courts Uphold Capped Sewer Ordinance" which requires subdividers to supply septic tanks and also sewers ready to connect to future trunk lines. By Ralph Lindenmuth, Solicitor of Marple Township, Pa. *American City*, August.

• • •

#### Aluminum in Highway Construction

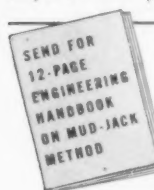
The Miami-to-Jacksonville Florida Turnpike, the first leg of which is scheduled for completion in January, 1957, will use more aluminum per mile than any other highway project in history. Now being installed are aluminum signs and sign posts, aluminum light standards and railings. Reynolds Metals Company is supplying the aluminum. The major components of the signs, posts, light standards and bridge railings are manufactured by the extrusion process. The signs are of new-type interlocking aluminum panels. The first leg of the turnpike runs from the Golden Glades Interchange near Miami north to Fort Pierce, a distance of 109 miles.



#### How Mud-Jack® stabilizes sub-grades

Here is an easy, low-cost way to raise settled sidewalks, street slabs, curbs, gutters, driveways. Koehring Mud-Jack pumps soil-cement slurry under pressure into small holes drilled through pavement. This displaces air pockets, water

or water-saturated materials, raises the concrete slab, leaves firm permanent sub-grade. Two sizes: compact, portable No. 10 for cities, and the big No. 50 Mud-Jack for preventive maintenance and low-cost repairs on highways.



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Correctly built in accordance with AWWA specifications. Send us your inquiry, stating capacity, height to bottom and location. Established 1854. Write for *Tank Talks*.

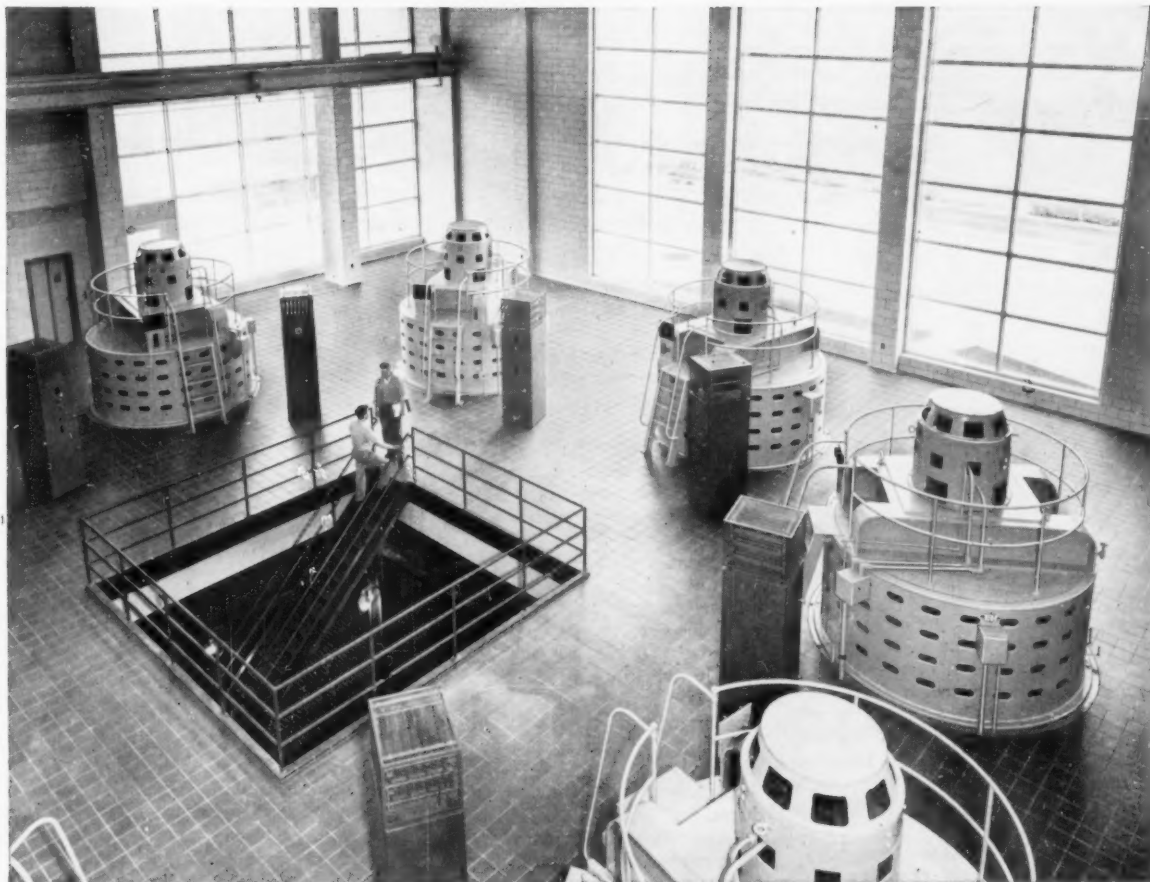


Elevated Tanks, Pressure Vessels, Chemical and Processing Equipment from Aluminum, Stainless and Carbon Steel, Monel and Other Alloys.

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NEWNAN, GEORGIA





## Here's how Detroit got flood-busting pump power for Storm Water Sewer System

Extensive rainstorm flood damage had been a problem that 150,000 residents of the Fox Creek District of Detroit faced each year. Existing storm sewers and pumping stations were recognized as being inadequate.

To end this situation, Detroit city engineers started a long-range area program. It included the installation of a new large storm water sewer system backed up by a series of pumping stations capable of pumping an enormous quantity of water, *fast!*

### Will Handle 30,000 Gallons a Second

The Freud Storm Water Pumping Station shown above is the third to be completed in the new system. Eventually this station will handle up to 30,000 gallons per second with the eight huge pumps installed there.

Eight rugged E-M Vertical Synchronous Motors and Controls are used to drive these huge pumps. Each motor develops 3000 horsepower at 225 rpm.

### Here's why E-M Vertical Synchronous Motors were chosen:

1. **HIGH EFFICIENCY** conversion of electric power to mechanical power by synchronous motors . . . results in minimum electric power cost operation.
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5. **SIMPLE STARTING** with "Conscious" Control by the E-M developed Polarized Field-Frequency Relay System.

Ask your nearest E-M sales engineer for vertical motor facts, and write the factory for E-M Synchroizer No. 43, the vertical motor issue.

**ELECTRIC MACHINERY MFG. COMPANY**  
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*Specialists in making motors do* **EXACTLY WHAT YOU WANT THEM TO**

# Water Works

## Bought to Finance Sewerage

C. E. WRIGHT

**T**HE STATE Constitution of Florida provides that the Legislature shall have the power to issue bonds only for "repelling invasion or suppressing insurrection." Districts, counties and municipalities may issue general obligation bonds only after such issuance "shall have been approved by a majority of the votes cast in an election in which a majority of the free-holders who are qualified electors residing in such counties, districts or municipalities shall participate." This has had a crippling effect on the improvement plans of some cities because even though the vote were 100 to 1 it would not carry if less than 50 percent of the freeholders had voted.

In this situation most of the municipalities of Florida have resorted to revenue bonds or certificates to raise the money needed for public works, as these do not require submission to freeholders. Of course this means that the investment houses which market the bonds must be satisfied that the backing is sufficient for service and amortization. Some form of easy collection is also essential. Many cities have adopted the plan of paying for sewer improvements by adding a percentage to the monthly water bills. This was the method that commended itself to the City of West Palm Beach, but the rub was that the city's water service was supplied by a privately owned company. West Palm Beach could devise no other method of collecting sewer assessments that would satisfy the investment bankers. So West Palm Beach conceived the idea of buying the water company.

A few months ago the city was successful in selling \$14,250,000 of revenue bonds, which are to be payable solely from water and sewer revenues. Proceeds are to be applied as follows: \$8,500,000 for purchase of the water system; \$1,250,000 for water system improvements and additions; and \$4,700,000 for constructing a sewage disposal system, of which \$200,000 is on hand.

Under a plan designed by Robert & Co. Associates of Atlanta, Ga., a sewage disposal plant will be built

on the site of an old incinerator and dump area. It will provide treatment by a modified activated sludge process. The plant units will include a Parshall flume and meter, primary settling tanks, aeration tanks and secondary settling tanks. The effluent from the secondary settling tank will be discharged through an existing 54-in. storm sewer to Lake Worth. Separate sludge digesters and sludge drying beds are included in the treatment facilities. A control building will house a laboratory, sludge pumps, heating equipment and blowers for the aeration units. Some of the blowers will be electrically driven; others will be driven by gas engines to utilize sludge gas. The engineers say that in all respects the plant will be similar to a standard activated sludge plant except that the aeration time will be reduced.

The collection system will run from south to north with interceptor sewers and pumping stations. There will be eleven stations, six on the lake shore, the rest in the western part of the city, all to be equipped with electrically driven sewage pumps. Some of the older developed sections of the city are now sewered and will require only the connection of existing sewers to the proposed trunk sewers. Five areas of the city which are not at present sewered

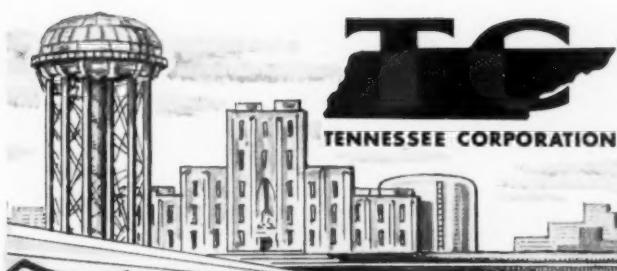
will be provided with lateral mains and house connections.

The estimated cost of the treatment plant is \$651,630; pumping stations will cost about \$281,730; force mains \$331,345; trunk and collector sewers \$708,625; lateral sewers \$1,233,155 and house connections \$657,350.

The cost of operation and maintenance for the first year is estimated at \$72,000, which will rise to \$100,000 in the tenth year. To obtain the necessary revenue to finance the project, it was proposed that a sewer charge be made based on the number of fixtures connected to a sewer. A rate schedule has been worked out with a minimum charge of \$1.50 a month for all dwelling units with four fixtures or less. An additional charge of 25 cents per fixture is to be made for all over four fixtures. Commercial and public buildings will be charged a minimum of \$1.50 a month for two fixtures or less, with an additional charge of 50 cents per fixture for the next ten fixtures. For all over twelve fixtures in either residential or commercial buildings, there will be a further charge of 15 cents per fixture. Although, as mentioned above, some Florida municipalities are charging a percentage of the water bill for sewerage, this was not considered a feasible plan in West Palm Beach where thousands of homes have private wells for lawn



● AERIAL VIEW of the water works purchased by the City of West Palm Beach.



## The Superior COAGULANT

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- ① Excellent Taste and Odor Control
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Ferri-Floc gives smoother, more efficient and trouble free operation. Whatever your particular water treatment problem may be, you can depend on Ferri-Floc doing a superior job and doing it efficiently and economically—Ferri-Floc is a free flowing granular salt which can be fed with few modifications through any standard dry feed equipment. It is only mildly hygroscopic, thereby permitting easy handling as well as storage in closed hoppers over long periods of time.

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Efficient coagulation of surface or well water. Effective in lime soda-ash softening. Adaptable to treatment of all industrial applications.

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Ferri-Floc coagulates wastes over wide pH ranges — It provides efficient operation regardless of rapid variations of raw sewage — Is effective for conditioning sludge prior to vacuum filtration or drying on sand beds.



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As an antichlor  $\text{SO}_2$  has proven to be very effective in controlling accurately the amount of residual chlorine in water supplied to the distribution system.

The quantity of  $\text{SO}_2$  needed to remove chlorine is in the ratio of 0.905 parts of  $\text{SO}_2$  for each part of chlorine to be removed or reduced.

For plants operating under conditions where control is difficult, superchlorination and dechlorination with  $\text{SO}_2$  is more practical than the "break-point" treatment.

Available in: Cylinders, Ten Drums, Tank Trucks and Tank Cars



### COPPER SULFATE

Long recognized as essential to properly control algae, and other microscopic organisms. Copper Sulfate will control about 90% of the micro-organisms normally encountered in water treatment plants more economically than any other chemical.

AVAILABLE IN 100 POUND BAGS.

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sprinkling, swimming pools, etc. Thus a percentage of water bills in such cases would not be compensatory for the sewer service. All residences and commercial establishments will be required to connect to the sewerage system and to pay the monthly sewer charge where such sewer service is available.

The Town of Palm Beach has also been dumping its sewage into Lake Worth, but in order that all pollution of this lake shall cease, it has worked out engineering plans for completion of its sewage collection

system with disposal through an ocean outfall. Sufficient general obligation bonds to cover the cost of this improvement, totalling \$2,700,000 were voted by the Palm Beach electors early in 1955 and the issue is being readied for sale at the time this article was written.

A water system already serves the Town of Palm Beach. This was originally built in 1894 by the Flagler interests when they were developing the twin towns of Palm Beach and West Palm Beach. Over the years it has been expanded to keep

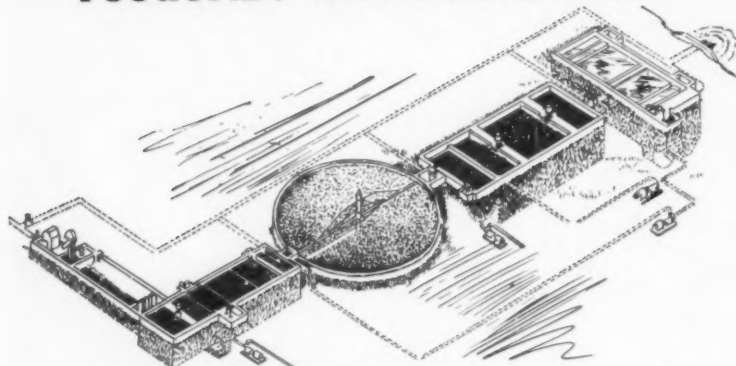
pace with the growth of the two communities and is now capable of pumping and treating 26,000,000 gal. of water a day. Its watershed covers approximately 100 square miles with a diked impounding area of 20 square miles. Treatment consists of aeration, after which the water passes through sand filters, then to a lime mixing chamber, after which it is treated with chlorine before discharge to a clear water storage reservoir of 1,250,000 gal. capacity. Located in the town of Palm Beach is an underground concrete reservoir of 1,000,000 gal. capacity with high pressure pumps that reinforce the pressures during heavy use periods. Water is replenished in this reservoir during off-peak periods.

With the acquisition of the water company, West Palm Beach gets a bonus of 17,000 acres of land, of which 4,000 acres west of the city can be immediately utilized for a much-needed expansion of the city and particularly to relieve the terribly overcrowded conditions in the Negro section. The remainder of the acquired property will pave the way for westward expansion. Two natural lakes in the northwestern area of the city, which are used for water storage, are also part of the acquisition. A supply canal linking the catchment area with waters from Lake Okeechobee is now in the process of construction. Thus the Palm Beach area should not ever be seriously threatened with a water shortage.

The water company has been so well managed that it won in 1955 citation from the Florida State Board of Health as the best operated plant in Florida cities of more than 25,000 population. Metcalf & Eddy, the Boston engineers made a thorough survey of the property before recommending its purchase by the City of West Palm Beach.

A deal of this size and importance is not often engineered, however, without some objectors. This was the case in West Palm Beach when a small group known as the Property Owners and Managers Association went to court to try to stop the water company purchase. The Palm Beach County Circuit Court found their intervention without merit and validated the bonds. On appeal, the Florida Supreme Court upheld the lower court's decision, whereupon the plaintiffs took the case to the U. S. Supreme Court. The bonds were sold despite this suit, however, on representation by the bond attorneys that in their opinion the appeal to the highest court was "without merit."

## why suffer MUNICIPAL WASTE MALODORS? reodorize with ALAMASK®



The use of ALAMASK reodorants creates a new approach to solving air pollution problems due to the handling and disposal of solid, liquid and gaseous wastes. At very low cost, ALAMASK can be used to achieve either a masking of the malodor created by municipal waste or creation of a condition that results in a non-objectionable odor.

ALAMASK has also proved its effectiveness in the abatement of objectionable odors emanating from

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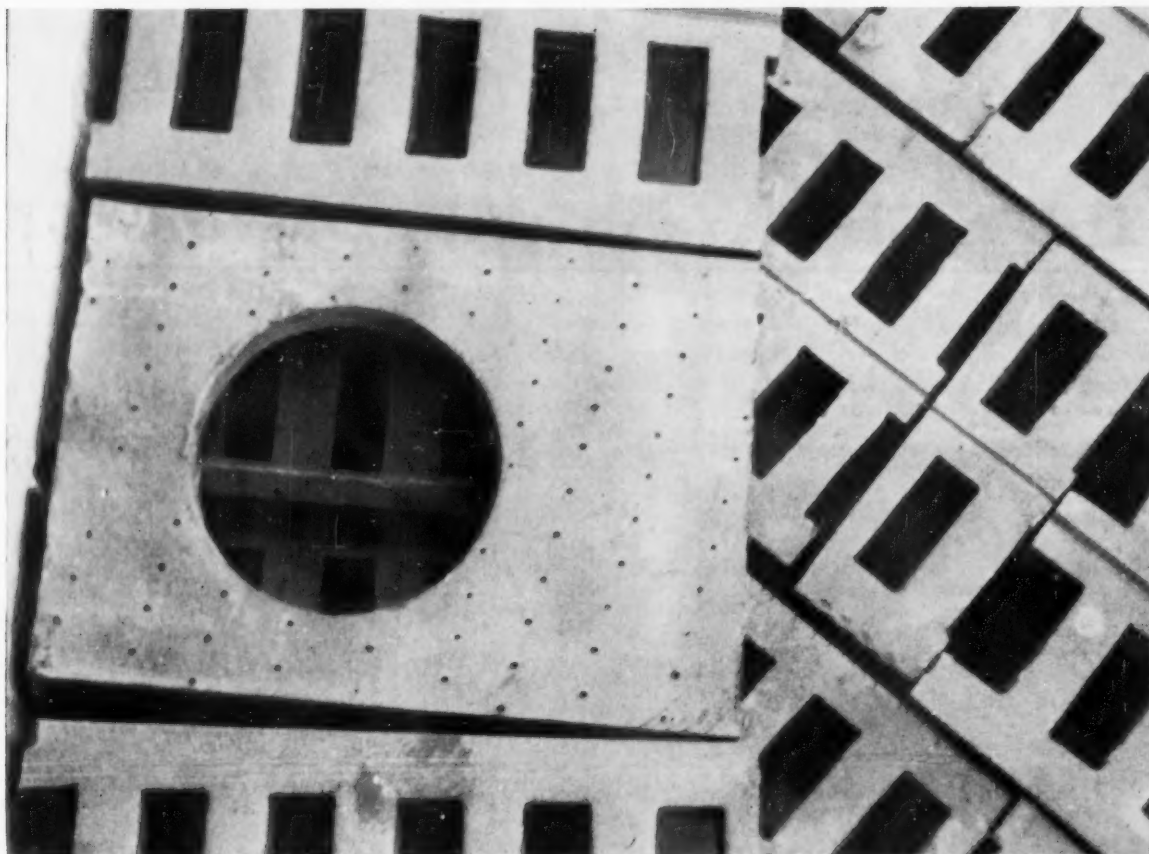
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This vent block for 4" VCP is now in service at Orient State Institute, Orient, Ohio.

## Ventilation Capacity for High Rate Loading

Let's consider the capacity of the longest block channel in a 100-foot diameter filter. Each Bosco channel is U-shaped with a lower radius of  $2\frac{1}{4}"$ , a height of  $3\frac{3}{8}"$ , and an upper width of  $4\frac{1}{8}"$ . If we assume this  $4\frac{1}{2}"$  channel flowing to a depth of  $2\frac{1}{4}"$  equals the rate of flow from a 4" clay pipe flowing half full at a velocity of 1.82 feet per second the discharge would be 51,300 gallons per day. The area served by this channel would be  $50 \times 0.4375$  (filter radius  $\times$  half the laying width of a Bosco block in feet) or 21.87 square feet. Dividing 51,300 by 21.87 equals 2,300 gallons per square foot per day or a gross load of 18 mgd on this filter at an application rate of 100 mg per acre per day.

This means that the rate of application must reach 100 mg per acre per day on this 100-foot filter before the channel draining the largest area in the underdrain system will run half full. For filters of smaller diameter the rate of application which will cause the block

to flow half full increases rapidly with the reduction in diameter of the filter. When flowing half full the channel will provide 7 square inches of cross sectional area for the flow of air.

These figures have been developed to show that ample opening is available to supply the air which will be moved by the natural forces causing circulation of air in a filter. Please note that we are referring only to the hydraulic capacity of the block to handle liquids—no consideration has been given to B.O.D. or the advisability of using such a high rate of application to obtain the desired removal.

Bosco underdrain block are vitrified, unglazed block which are produced in strict accordance with ASTM specifications for Type I underdrains.

Please write Department F, The Bowerston Shale Company, for test reports and drawings.

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# THE HIGHWAY AND AIRPORT DIGEST

## Quality Control Of Concrete in Indiana

Close laboratory control and intelligent cooperation between engineers and contractor saved approximately \$30,000 worth of portland cement on one 13.92-mile section of the Northern Indiana toll road, without sacrificing specified flexural strength of 700 psi. Trial mixes and strength tests by a supervisor for Associated Professional Engineers were made in a field laboratory. An inspector took test samples of concrete from the mixer and cast and tested 6 x 6 x 36-in. beams, 4 each day. Samples taken every 750 ft. were tested for air, to maintain 4% to 6% air content. These tests supplemented others made for the Toll Road Commission by the Pittsburgh Testing Laboratory.

"Close Control of Mix and Over-run Saved Contractor \$30,000 in Cement." By Hubert C. Persons. *Roads and Streets*, August.

## Reducing Time Of Plan Preparation

The Texas Highway Dept. has been developing ways of reducing plan-preparation time and estimates that those already adopted have saved about 40% in man-hours and 60% in engineering costs. They reproduce plans from penciled tracings on paper, from which cloth tracings can be reproduced, if more permanency is desired, by photography; the print is made in reverse so that corrections can be made on the other side of the cloth. They also make reproduced tracings of blank summary sheets, typical cross-section sheets and estimate and quantity sheets, leaving only the figures themselves to be entered. New employees can do lettering more quickly and neater with pencil than with pen. Standard title sheets are photographed onto plans. In making a right-of-way purchase, aerial survey plans are photographed, enlarged, and the proposed route superimposed on it.

"Short Cuts in Preparation of Plans." By Fred T. Bennett. *Better Roads*, August.

## Keeping Engineers In Highway Departments

Wide publicity has been given to the necessity of obtaining more engineers for highway departments. Less is said about the even greater necessity of retaining the trained engineers which the departments already have. Many highway departments are losing trained engineers more rapidly than they are able to hire untrained ones. Discussions of this subject were received by The Highway Magazine from city and county engineers, personnel officers, design engineers and others from all over the country. Most of them mentioned 5 basic considerations: 1) Work that tests their knowledge and imagination and makes efficient use of their professional talent; 2) promotional opportunity and protection against arbitrary dismissal or "pigeon-holing"; 3) adequate compensation based on ability rather

than years of service; 4) training programs that will help them to advance to greater responsibilities; 5) recognition and prestige in accord with their professional status and importance to the organization. Other points mentioned were liberal sick leave, special retirement plans; vacation privileges; and other fringe benefits.

R. F. Milhaupt, personnel officer of the Wisconsin State Highway Commission, described how that state is solving the problem. It has increased engineer's salaries, establishing a true competitive salary plan based on merit; and has broadened the organizational structure at the top supervisory levels. Among the intangible benefits are an efficient training program, better utilization of professional engineering talent, and recognition in keeping with the engineer's training and technical knowledge.

"Engineering Manpower a Critical

## Surfacing Progresses on Sunshine State Parkway



**P**AVING on several sections of the Sunshine State Parkway got under way during the late summer months as work on the turnpike moved toward completion. Workmen shown above are putting down a 1½-inch binder course which will be followed by laying the final 1-inch wearing surface.

Contract for this section of the Parkway, a 30-mile section between Miami and Ft. Pierce, is being performed by Rubin Construction Co. of West Palm Beach. It is expected that all surfacing work will be completed before the turnpike's scheduled opening date of January 1, 1957.

# DO YOU REALLY NEED A "BIGGER" MOTOR GRADER THAN THE **CAT\* NO. 212?**



Bigness isn't a matter of weight or horsepower. It's the *work capacity* of the machine.

The City of Lewisburg, Tennessee, found that out when they needed a new motor grader. Every competing make was given its chance, but the city bought a Caterpillar No. 212. The reason was that they discovered it could do every type of grading, ditching, backfilling and black-topping more economically than the other machines.

While it's the smallest and lowest-priced motor grader Caterpillar builds, the No. 212 has proved repeatedly that it can do the same jobs the bigger machines can do, at slightly slower speeds.

The 50 HP No. 212 gives you nearly all the advantages you get in the more powerful Cat Motor Graders. It's completely *built*—not merely assembled—by one responsible manufacturer, and it has typical Caterpillar strength and dependability. Some of its plus values are:

tandem drive and leaning front wheels; mechanical power controls, easy to operate and positive-acting; easy, accurate steering; a full range of blade positions (you can move the blade from ditching to bank-sloping position in less than a minute, without leaving the platform); and full visibility of the job from the seat.

Low first cost, long work life and all-round job ability make the No. 212 an ideal buy for many communities. Your Caterpillar Dealer will gladly give you a demonstration, and you can count on him to protect your investment with reliable parts and service.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

## CATERPILLAR\*

\*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

**NAME THE DATE...  
YOUR DEALER  
WILL DEMONSTRATE**

Problem for Highway Departments." By Timothy A. Harrison, Editor, The Highway Magazine. PUBLIC WORKS, September.

## Two-Way Radio In Champaign County

The Highway Department of Champaign Co., Ohio, considers its two-way radio the best and cheapest maintenance and construction tool it has. Its use saves time for men and mechanical equipment, makes possible quick action in emergencies, and improves public relations by providing prompt attention to complaints. While a motor grader or bulldozer costs \$12,000 or more, one base station and six mobile units, the transmitters having a power output of 60 watts, cost only \$5956, and the maintenance the first year cost \$184.83.

"Two-Way Radio Used in Maintenance and Construction." By North H. Newton, County Engineer. PUBLIC WORKS, September.

## Aerial Photos Available at Little Cost

Henry County, Iowa, realized the advantages to a highway department of having aerial photos, but it was

financially out of the question for them to have the county photographed. However, the engineer learned that the local agricultural office possessed sets of outdated aerial photos, which he was able to obtain. These photos cannot be used for stereoscopic viewing but otherwise serve the purpose. If the latest prints are needed, they can be viewed at the agricultural office. The photos are used for checking or obtaining drainage areas for culverts. The county also uses soil maps put out by the government which show stream and creek drainage lines.

"A County Finds Many Uses for Aerial Photos." By Melvin B. Larsen, County Engineer. PUBLIC WORKS, September.

## Flagging Traffic Around Construction Jobs

In handling traffic past a construction or maintenance job, one of the most important considerations is the flagman. He should be fairly young, active, mentally and physically alert and intelligent. While flagging, he should stand still, in a position where all approaching cars can see him, on the shoulder or in the lane which he wishes to control. When

speaking to a driver he should always stand on the passenger's side. He should be neat in appearance and maintain an air of authority. It is suggested that he wear a bright red zipper jacket slipped over his work clothes, and a yellow sun hat with the words "Traffic Control" across the front.

"Handling and Protecting Traffic During Road Construction and Maintenance." By B. R. Downey, Maint. Eng., Michigan Highway Dept. *Roads and Streets*, August.

## Changes in New York Thruway Specifications

After a year's operating experience, engineers of the New York Thruway have modified some of the design specifications for all new sections. Superelevation will be applied to curves with radius up to 7,500 ft. instead of 5,000 ft., not for safety but for comfort of automobilists. Stabilized shoulders will be increased to a uniform 11 1/2 ft. in cuts as well as fills; they were formerly 10 ft. in cuts. Median strips will be 104 ft. wide, to permit future widening, if needed, to be made on the inside instead of outside of the road. At one place, as a test, a single restaurant-gasoline comfort station



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will be placed on one side of the road only, with an overpass for vehicles. Regular service areas are now about 30 miles apart; in addition, 14 rest areas will be provided, with parking spaces and minimum facilities.

"Thruway Engineers Modify Some Design Specifications." *Engineering News-Record*, August 2.

#### "Permanent Dust Treatment" of Unpaved Streets

Akron, Ohio, contains 800 miles of streets, of which 400 are unpaved, yet carry heavy traffic in densely populated areas. These are treated with dust palliatives. After a few years a hard, solid asphaltic mat has formed which, however, breaks up at intervals. In 1949 an experiment was tried on two heavily traveled streets on which such mats had formed, with a view to obtaining at low cost a more permanent surface. This was a double treatment, each consisting of the application of 0.25 gal. of asphalt emulsion AE-14 per sq. yd., followed by 26 lb. of No. 6 slag per sq. yd. thoroughly rolled, and then a fog coat of asphalt emulsion AE-15. Under traffic a few holes developed from time to time, but the surfaces held up amazingly

well and are still in excellent condition. This treatment, which cost about \$1.25 per front foot, was applied to 21.92 miles of streets in 1953, 1954 and 1955.

"Permanent Dust Treatment for Akron." By H. A. Mathews, Office Mgr. PUBLIC WORKS, September.

#### Traffic Counts On Rural Roads

Tompkins County, N. Y., finds traffic counts to be very desirable for several reasons. These furnish data to aid in assigning priority for road improvements and locating traffic signals; taken over a series of years, they show traffic trends. Traffic counts may be made by keeping tally with paper and pencil, or by use of machine counters. In some cases automatic counters are installed permanently; usually only by state departments because of their high cost. The portable counter most commonly used on rural roads counts the number of vehicles that pass over a rubber tube, some of them printing on a paper tape the totals every 15 minutes or other interval of time. A count for 2 to 5 consecutive days at each point is recommended.

"Rural Traffic Counts—The Why

and How." By William C. Burnett, of Tompkins Co. Hwy. Dept. PUBLIC WORKS, September.

#### Other Articles

"Steps in Solving a City's Parking Problems" in Watertown, N. Y. By C. Leland Wood, City Manager. Public Works, September.

"Snow and Ice Control" in Genesee Co., N. Y. By Robert T. Carrier, Supt. of Highways. Public Works, September.

"Steam Cleaner Helps in Snow and Ice Control" in Brown Co., Wis. Public Works, September.

"Public Relations on a Highway Construction Job." By K. R. McDonald, Public Works, September.

"Rubber in Roads." Progress made in 1955. Report of the British Natural Rubber Development Board. The Surveyor, July 14.

"Highway Weed and Brush Control." Instructions for selecting and using chemicals. By Homer Jacobs, of Davey Tree Co. Public Works, September.

"New Standards for Interstate Highway System Approved." By Com'r of Public Roads. Public Works, September. Better Roads, August.

"Airstrips Pose Growing Maintenance Problem." By Harold J. McKeever, Editor. Roads and Streets, August.

"Old Spans Used in Erecting Illinois First All-Welded Girder Bridge." By V. L. Farley, of Div. of Highways. Roads and Streets, August.



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# THE HIGHWAY PROGRAM:

## OPPORTUNITY and CHALLENGE

IN GENERAL the state highway departments, subject to approval by the Bureau of Public Roads, will have full responsibility for programming and supervising all construction on the Interstate and other federal-aid highways. Some state highway departments require formal approval by the city of all highway programs within the city's boundaries. One state, Texas, has established an urban division within the highway department which is responsible for planning urban highways. Other state highway departments have already taken steps to add to their staffs engineers and other technicians familiar with the complex problems of highway construction in densely populated areas. In some cases municipal, state and federal funds have been used to hire consultants to design urban expressways.

Even though they have limited direct responsibilities, municipalities still have a key role to play in partnership with state highway officials. The extent and the effectiveness of the cooperation with and by the state will in large measure determine the effectiveness of the program. A highway obviously does not end at the city line. It has its origin and continues through surrounding towns and counties. It crosses state borders. It passes through school districts, water districts, and other political and taxing jurisdiction. It will be necessary to work very closely with surrounding communities to insure that all get maximum benefit from the facility. This may mean a revision of local ordinance, the city charter or even state statutes to provide the necessary authority to deal with other jurisdictions.

### City Street Plan

Planning an express highway or a limited access highway is like planning a water system. The pipes—or in this case the streets—must all fit together to create an integrated system. Each city must develop an overall city street and

**BERNARD F. HILLENBRAND**

Assistant Director

American Municipal Association

highway plan. An interstate circumferential route, by-pass or spur into the center of the city must be co-ordinated with the local sections of the federal-aid primary and secondary and particularly with the urban extensions of the primary system. In developing an overall plan consideration must be given to all traffic arteries whether state highways, county roads or city streets.

Many communities have taken extensive traffic counts, made origin and destination studies and have other data upon which to develop an overall city street plan: This is a job for the city planners. The traffic engineer or his equivalent also has a major role in this phase of the program. He knows from past experience that traffic is highly sensitive to improved facilities. A new highway, a widened street, even a new signal light produces changes in the flow of traffic that must be taken into consideration.

### Mass Transit and Parking

Many cities will now be giving serious consideration to providing turn-outs, ramps and even special traffic lanes on the new facilities for use of mass transit.

An equally pressing problem is that of providing parking space. Communities have discovered that with the completion of a freeway there is a new demand for parking facilities. Some argue that no plan for highways is complete until it has made provision for off-street parking. Ideally, an expressway into a city would have a sufficient number of exits to channel off traffic smoothly onto other highways and city streets and would provide off-street parking at the traffic destinations. One provision of the new road act allows a state or city to use the air space over and the space

below any section of the Interstate System for providing parking facilities.

There are strong financial incentives to coordinating redevelopment plans with a road building program. If a proposed new highway serves a redevelopment project, the community can claim credit towards its one-third share of the net cost of the redevelopment project for the non-federal money including state, county and city which is spent for the road improvement. This includes the local matching funds for the expressway itself and for local funds spent for improvements on city streets and approaches to the expressway if they serve the redevelopment project. There is no credit given on the redevelopment project for federal funds spent on the highway improvement.

It is estimated that up to 85 percent of the Interstate System will be built on new locations. Nearly 7,000 miles of the system will be constructed within metropolitan areas. Land acquisition within urban areas is estimated at about \$5 billion or almost one-third of the cost of the projects. About one million acres of land must be acquired for the Interstate System alone. One of the major efforts in the entire program will be to acquire this tremendous amount of land as quickly as possible and with justice both to the public and the owners. Advance acquisition will enable the right-of-way to be acquired before development inflates the cost. It also will enable the entire program to progress with less strain on those who must relocate.

In establishing the Interstate System, Congress provided for controlled or planned access. This means the reduction in the number of points of exit and entrance and of the number of gasoline stations, restaurants and other roadside facilities.

There are likely to be demands for more interchanges than the engineers think desirable. In smaller municipalities there will be many cases when the highway will bypass the town. Provision has been made requiring that no bypass can be made until the economic effects of the bypass are considered and until a public hearing has been held.

### Relocation of City Utilities

Once construction is undertaken municipal utilities, such as water, sewers, fire and other signal systems, power transmission facilities and other underground or overhead utilities, will be in the path of the



highway and will have to be relocated. There is a provision in the road bill by which the federal government will reimburse the state if the state chooses to pay the cost of these utility relocations. If the state does not authorize payments for utility relocations, the federal government will make no payments either. In any event the federal utility reimbursements to the states are limited to the Government's pro rata share of the highway system involved. It will reimburse the state 90 percent of the amount the state pays for the relocation cost on the Interstate System and 50 percent of the cost on the other federal-aid highways.

When the highway is completed, it is often the practice for the state to have the municipality assume responsibility for lighting, snow removal, repair, marking and traffic control and policing. In some states the maintenance and policing is a cooperative undertaking. The state reimburses the city on a predetermined basis such as the number of square yards of road involved or some other measure. City officials, like most other citizens, have discovered that the dollar doesn't go very far and that often the states' contributions for maintenance, established long in the past, are unrealistic. These should be carefully reviewed in the light of present experience or the municipality runs the risk of a high maintenance budget.

During the next decade municipal and state officials will face some very challenging problems when they undertake the greatest peacetime public works program in the history of the world. They will of necessity have to work in close cooperation with each other and, equally important, with the public. It will be important to keep the press and the public as fully informed of what is being done and why as possible. Ample evidence of vast public support for the road program came during the long debate on the road bill when no one seriously questioned the need for better roads. This program has been sold to the highway user and the public as a pay-as-you-go program which will see the completion at the end of 13 years of a system of super interstate highways built to standards to meet 1975 traffic loads. In exchange for this program, the public has indicated an overwhelming support for the increases in highway user taxes to pay the bill.

This article has been condensed from the *Florida Municipal Record*.

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# Methods of Financing Water Main Extensions

CONSIDERATION OF THE various policies governing financing of water main extensions indicates that there are three basic and underlying philosophies in use. Any procedure adopted by a municipality that is not a compromise will fit into one of three fundamental principles which may be denominated as (1) the public utility concept, (2) the community improvement concept, and (3) the property improvement concept.

**Public Utility Concept**—Where mains have been extended in accordance with rules based on the public utility concept the investment by the utility is limited to a specified amount for each customer.

In Wisconsin the more prevalent practice where the utility concept prevails has been to extend the width of a normal lot for each customer. Most such rules limit the so-called free extension to 50 feet and some rules were based on 66 feet. Some years ago (about 1915 and again in 1935) 50 feet of 6-inch main cost about \$50 installed. The present cost of such main would probably be not less than \$175. Rates for water service have increased but not by a corresponding amount. When the

cost of 50 feet of water main was about \$50, the 4 times annual revenue limit on free extensions was approximately equivalent to a 50-foot extension. With existing construction costs and water rate levels the allowance of 4 times annual revenues would be more nearly equivalent to 20 feet of 6-inch main.

To follow the utility concept without compromise would be to establish such extension rules that a normal concentration of customers would result in all of the investment being borne by the utility. Where such a policy is employed, revenues from water service must be sufficient to provide a reasonable return on the additional utility investment. With present day operating ratios and interest rates it is suggested that the utility could invest up to 8 times anticipated annual revenues or about 46 feet of main for each customer based on a cost of \$3.50 a foot and annual revenues of \$20.

**Community Improvement**—The community improvement concept means that mains are extended with utility funds as long as such funds are available and after that with funds furnished by the municipality or from borrowing. This concept dif-

fers from the utility concept only in that there is no limitation on the extent of the investment except that an effort is made to make service available in the entire developed area with no contributions from customers or property owners.

The utility with the community improvement philosophy will develop a serious problem in obtaining funds for expansion unless the governing body cooperates to restrict the area included within the municipal limits. An advantage of the community development idea is that a minimum of record keeping is involved.

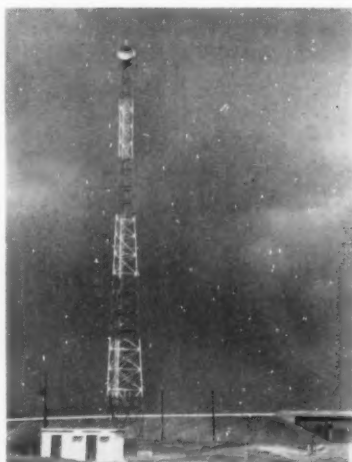
Another advantage is complete control of the main extension program by the utility without interference to meet customer demands or the exigencies of an assessment program. A serious disadvantage is the amount of investment required and the fact that applicants for service who are required to make no immediate financial outlay may prove to be unreasonable in their demands for main extensions.

**Property Improvement**—The property improvement concept assumes that any extension of water mains should be considered as a benefit to property and that the cost should be paid by the owner of the benefited property. The method of collecting would be to make an assessment against benefited property which would involve the taxing powers of the municipality. There is a practical limitation to such a procedure, in addition to limitations imposed by statute, because the value of the property after improvement must exceed the assessment. Should the assessment against any parcel of land exceed the value, the property may be allowed to become tax delinquent property. Development of a community-wide water supply could be somewhat slower than where other methods of financing mains are in use because the municipality will not usually make an assessment over the objection of 50 per cent of the property owners affected.

An obvious advantage of the property improvement concept is that it eliminates the need for utility or general fund financing of extensions except for street intersections and temporary financing between the time of installation and the date on which the assessment is paid. Disadvantages of the property improvement concept are the possibility that community development will be delayed and the loss of time between a decision to make an ex-

## Communications on the Indiana Toll Road

AN INSTANTANEOUS communications network along all 157 miles of Indiana's Northern West-East toll road was ready for operation on September 17th when the super-highway opened for cross-state traffic. Engineered by the General Electric Company, the half-million dollar installation extends in both directions from a control center near South Bend. Complete integration of mobile units, telephones and teletypewriters located at various points along the road is provided by the combination microwave-VHF system. In all, GE is providing seven microwave stations, 10 VHF stations, a dozen fixed station units for toll plazas and 65 mobile radios for use in maintenance vehicles, tow trucks, snow-removal units and by police.



● TOWER is one of seven used to relay signals on line-of-sight paths.

tension and the completion of statutory requirement preliminary to assessing benefits to property.

To obtain a sample of the comparative popularity of the three usual methods of financing water main extensions a survey was made of the information on file with the Wisconsin public service commission. The survey was limited to 16 class A water utilities (annual revenues of over \$300,000) and 57 class B water utilities (annual revenues of between \$150,000 and \$300,000). Of the 16 class A utilities records show that 11 assess the cost of main extensions to benefited property owners, 2 extend mains with utility funds and 3 operate with a rule that limits the investment by the utility to a specific amount in dollars invested or a specified distance for each new customer. The 43 class B water utilities have practices as follows: an assessment policy is used by 22 communities; mains are placed at utility expense by 13 water utilities in the group; and a rule limiting the investment by the water department was on file for 8 utilities.

Information with respect to the amount of the assessment shows that it varies from 50 cents a foot to the full cost. Utilities with a specific limitation on the length of extension for each customer allowed either 50 feet or 66 feet of main for each new customer. One utility will invest up to \$200 for each applicant for service and one reported that main extensions are made at utility expense if the cost does not exceed 5 times the annual revenues from the extension.

**Considerations in Policy**—The decision as to which policy should be followed rests with the water utility and the municipality unless unreasonable discrimination would result from a proposed main extension rule. Important items for consideration in connection with an extension policy are: (1) the desires of the municipality with respect to growth and the effect of a particular water main extension policy on community development. (2) The availability of funds. (3) The value of improved property as compared with unimproved property. (4) The interests of present rate payers as compared with the future customers.

Real estate developments are frequently given special treatment because no customers are immediately available. When mains are assessed in full no problem is present with extensions into real estate developments. Where there is to be a partial assessment it would be possible

to require the developer to advance the difference between the amount to be assessed and the total cost. Such amounts should be subject to refund when customers connect if such connections occur within a reasonable time after completion of the extension.

Where the community development concept or the public utility concept governs water main extension financing, a real estate development rule could require the developer to advance the cost with a provision for refunds of such advances as customers connect.

General historical trends have been discussed with respect to water utility main extension policy as shown by the statutes and by information found in the commission files. In brief, the trend was from a general application of assessment of benefits to a wider use of the so-called free extensions with customer contribution when specified limits were exceeded and a reverse trend in recent years to wider use of the statutes for assessment of benefits to property. The attitude of the public service commission and of the supreme court has been



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## 'Pulls work while traffic moves



## rebuild Douglas County road fast

When officials of Douglas County, Ore., decided to widen 7 miles of South Myrtle Creek Road, they faced a traffic problem. The existing road was narrow. Roadbuilding equipment would have to use this road as a haul road, without disrupting normal traffic.

### Problem solved by Tournapulls

Douglas County Highway Department decided to handle the job with their two rubber-tired D Tournapulls, using a crawler-tractor to push-load. Objective was to widen cut on a curve and spread diggings on existing road shoulders.

On this job each "D" (with sideboards) carried about 9 yards of mixed shale and clay. Average 500' cycle took about 4½ minutes de-

spite heavy traffic on haul road. During 8-hour working day each "D" moved an average 1,450 yards. "D's" 90° turnability, and 29.5 mph travel speed, gave fast maneuverability needed for low-cost-per-yard dirt handling. As a result, job was finished with minimum inconvenience to taxpayers.

### "Easier to operate than a truck"

The two D Tournapulls were driven under their own power from Glide Little River to Myrtle Creek, a distance of 55 miles in 2¼ hours. Supt. Wesley L. Corn commented, "These 'D's' are fine machines, always ready to take off when we need them." Operator Virgil C. Jennil said "'D' is the easiest operating machine a man can drive... and easier on a man than a truck."

Improved D Tournapull, now has maximum 9-yd. heaped capacity, 8' width, and permissible axle-load... requires no special road permit. Get all the facts.

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WESTINGHOUSE  
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Peoria, Illinois

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After dumping 9 yards of shale and clay on existing road, "D" makes 180° turn within 26 ft. Despite cramped quarters "D's" averaged only 4½ minutes on 500' cycle.

that a water utility may lawfully change its main extension policy even when the change results in charges which might be considered as unreasonable in comparison with past practices.

This material was prepared by Orville P. Deuel, Public Utility Rate Analyst, Public Service Commission. It appeared in *The Municipality* published by the League of Wisconsin Municipalities.

### Traffic Control Devices

*(Continued from page 134)*

accommodate the thousands of vehicles which visit the new centers daily.

Legal authority to require certain traffic protection and control features as a condition for access permission to such installations as shopping centers and large industrial plants would appear to be desirable.

### One-Way Streets

Somewhat distinct from the accepted understanding of channelization, but of similar objective in traffic control and design, is the one-way street operation. The subject is too broad and too ramified to discuss in this space, but should neither be overlooked nor minimized in any traffic planning program. Of interest to planners today is the fact that the utilization of one-way operation for specific problems is spreading from the downtown areas of metropolitan centers, where the one-way systems started and where they are still most widely used, to suburban areas, particularly to those very heavily built-up areas immediately adjacent to cities, and even to some distinctly rural area. It may be suggested that this trend will be accentuated as more experience is accumulated, and as public acceptance of this method of providing safer, more efficient, and more economical traffic movement, becomes more general.

Built-in safety features and traffic control devices inherent in modern street and highway design will eliminate the necessity for much of the intersection reconstruction expedients of the past and present. It nevertheless appears probable that for all time to come, channelization and the objectives of channelization, will still be required, whether as a built-in feature of the original construction, or as an expedient to accommodate changing conditions.



A rather new development in pavement marking is the trend to use the painted lines to delineate the pavement edge. Where shoulders are stabilized or otherwise adequate for turnout movement, this new marking procedure is being tested in experimental studies.

Manufacturers continue to work on development of beaded paints which will heighten visibility under artificial light when roadways are wet. Many agencies are experimenting with low glare fluorescent lighting for streets and highways, and with more adequate lighting of traffic conflict points and areas of high traffic volumes.

• • •

#### Winter on Ohio Turnpike

(Continued from page 98)

side and 10-foot outside shoulders of penetration macadam construction.)

During a typical snowstorm, abrasives are spread as early as possible in order to get underneath the snow and to prevent a frozen packed layer of snow from adhering to the pavement. During snowstorms of any depth, it is the Commission's practice to operate its plows in tandem, using one plow to move the snow from the inside lane of the pavement to the left shoulder and a second to move the snow from the outside lane of the pavement to the right shoulder area. A follow-up plowing of the shoulders is accomplished as soon thereafter as possible to prevent the windrowed snow along the pavement from melting or drifting back onto the pavement and to permit the shoulders to be used for emergency purposes.

From the first winter's experience the Commission has been able to learn a great deal about the peculiarities of snow and ice removal on a modern turnpike with the type of winter weather conditions which plague northern Ohio, and will improve its procedure for the coming winter accordingly.

The Commission has found that the greatest asset to a maintenance program is to have an organization of the highest type, where each man is thoroughly trained and has learned to think for himself, to assess and evaluate changing conditions and to be able to assume responsibility for making decisions when unexpected situations arise. It is the sum of the skills and good judgment of these individuals that results in a good maintenance organization, which in turn assures an effective maintenance program.

PUBLIC WORKS for October, 1956



Maintains landfills

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One D Tournapull does the work of several pieces of high-priced specialized equipment. It does the basic jobs illustrated and many, many more... as a scraper, hauler, spread unit, snow-plow and utility dozer. This fast, self-propelled unit works economically on both big and small assignments. And when job is finished, handy "D" runs to the next project at speeds to 29.5 mph.

7½-yd. "D" has more capacity than average dump truck... can be shovel-loaded. Normally, however, it self-loads, travels where a truck cannot go, and spreads in places where needed. "D" is faster, more maneuverable, more versatile than any crawler-scraper combination. Rig can handle two or three widely-separated assignments in a single day. It's an all-around, one-man maintenance crew.

You will like the way "D Handyman" moves refuse and dirt on sanitary landfills, helps eliminate odors and vermin. How it cleans ditches, builds up road shoulders, daylight curves, gravels roads and streets, and keeps your voters happy.

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Grades roads



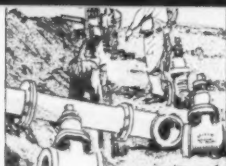
Rebuilds shoulders



Plows snow



Backfills around culverts



## PUBLIC WORKS DIGESTS



# THE WATER WORKS DIGEST

### Automatic Controls Being Adopted for Water Works

Transmission, evaluating and control elements necessary for automatic control in water plants are all available. Sensing devices are offered for measuring chlorine residual, pH, oxidation-reduction potential and conductivity, as well as pressure, temperature and fluid flow; and work is far advanced on devices to measure, on a continuous basis, turbidity, fluorides, hardness and sludge density. Eventually devices will be perfected for continuous measurement of BOD, bacterial content, ammonia content, and volatile acid content of digestion tank liquor. The various devices are described and plants employing them are cited. Complete automation of water and sewage works will involve automatic analyzers and computer mechanisms in the laboratory. Safeguards, including electronic eyes, X-ray microscopes and closed-circuit television will also be necessary.

"Automatic Controls: Next—Full Automation?" Engineering News-Record, August 2.

### Water Districts for Building Storage Reservoirs

In many areas where large multi-purpose reservoirs cannot be justified, small reservoirs for stream control would be extremely useful. Reservoirs cannot be built economically by private corporations or small communities and, as the demand for storage increases, construction by public or semi-public water districts seems certain. Such districts should have the power of eminent domain; under present tax laws they can borrow money at low rates. Legislation would be required in many states to permit the establishment of such districts, but public opinion is generally favorable. In some areas, the demand for water is such that a district formed to develop the water resources could arrange in advance for guaranteed annual payments by the municipalities

and industries to be benefited. These guarantees would serve as the basis for financing revenue bonds. In areas where the immediate revenue would not finance the entire cost, it may be advantageous to the community to underwrite some of the expense in order to encourage its industrial development. Except where there are natural ground water resources, the prospects of developing additional water supplies by methods less costly than storage are poor in most eastern states. Communities should band together and join with industry to develop these resources now, while the necessary sites are still available.

"Economics of Stream Flow Regulation: By Richard Hazen. *Jour., AWW Ass'n*, July.

### Chlorinating Deep Reservoirs

Los Angeles, Calif., operates 16 major reservoirs, which vary in maximum depth from 25 to 130 ft. Summer stratification of the deeper ones creates taste and odor problems. The hypolimnion suffers oxygen depletion, causing anaerobic decomposition of organic matters which have settled there. It was thought that this could be prevented or lessened by supplying oxygen or chlorine directly to the hypolimnion. In 1953, air was forced by pipes to the bottom of the reservoir which had given the most trouble, and this was slightly beneficial. In 1954, chlorine was forced into the hypolimnion through a grid of iron pipe

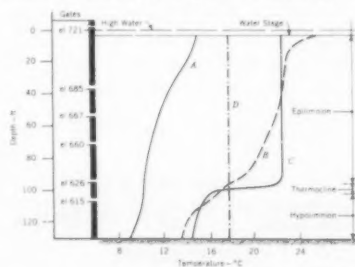
about 2 ft. above the bottom, but did not diffuse sufficiently through the entire bottom stratum. In 1955 an attempt was made to increase the diffusion by circulating the water in the hypolimnion, pumping it up at one point, chlorinating it and discharging it into the same stratum about 350 feet away through a perforated pipe. The results of this were encouraging. Application of gas at a depth of 85 ft. in another, shallower reservoir was tried in 1955. These procedures have greatly reduced the tastes and odors. Still better results are hoped for this year.

This is only a palliative; prevention of the formation of this anaerobic stratum might be made possible by better planning. This should provide sufficient gate area at enough elevations, the lowest gate within a few feet of the bottom to permit removal of the entire hypolimnion before oxygen depletion can take place.

"Chlorination of Deep Reservoirs for Taste and Odor Control." By Ray L. Derby, of the Dept. of Water and Power. *Jour., AWW Ass'n*, July.

### Providing for Peak Demands

Capacities of reservoirs or tanks and of distribution systems should be based on peak demands. Ordinarily, the pumps are designed to meet the maximum daily flows, while the hourly peaks will be supplied from storage. A study of conditions in Baltimore, Md., showed that the average daily consumption varies from 234 gpcd in mixed residential and industrial neighborhoods, to 80 in exclusively residential ones. The peak hour in the former was 50% greater, but in the residential area was 276% greater, and probably more in small areas. Other cities have found demands lasting for one or two hours reaching 900% of the average daily demand. The writer suggests providing for peak demands exceeding average day by 500 to 600% in old neighborhoods with small lots; 900% in new neighbor-



Courtesy Journal AWWA  
● CURVES show temperature changes  
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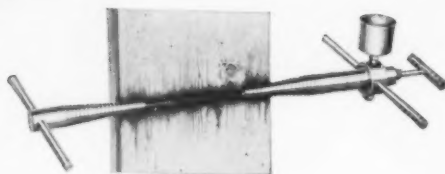
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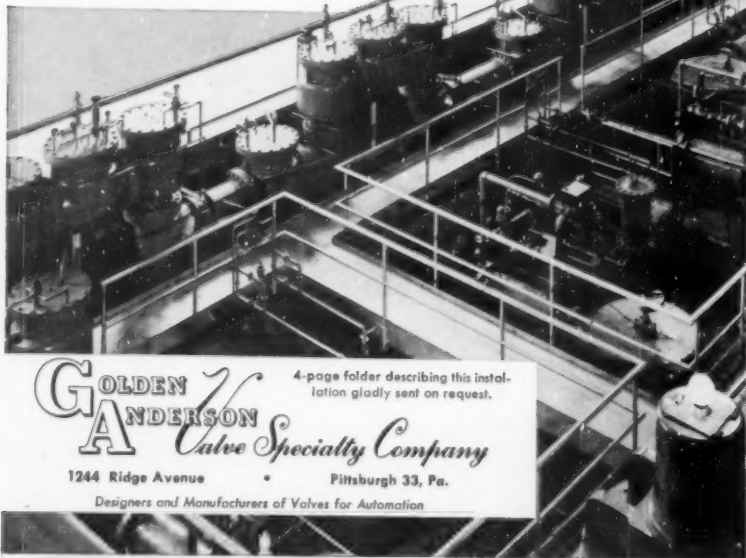
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hoods with lots of  $\frac{1}{4}$  to  $\frac{1}{2}$  acre; and 1500% where the lots are from  $\frac{1}{2}$  to 3 acres.

"Analysis of Peak Water Demands." By Jerome B. Wolff, Deputy Chf., and John F. Loos, Chf., Water Design Div., Baltimore, Md. PUBLIC WORKS, September.

### Rapid Sand Filter Plants

The author has collected up-to-date data concerning filters in service in cities of 100,000 population or over in the United States and Canada. Of these, 79 are using rapid sand filters, and 14 are using slow sand filters, one (Albany, N. Y.) holding old filters in reserve, and Lowell, Mass. using them for iron removal. No filtration plants are used by 48 large cities, 15 of which obtain their supplies from wells and one from an infiltration gallery. The data for individual plants, presented in tables, include population; consumption; source of supply; analysis of raw water; details of mixing, sedimentation, filtering, and filtered water reservoir.

"Design and Operation Data on Large Rapid Sand Filtration Plants in the United States and Canada." By Kenneth W. Cosens, Assoc. Prof., Ohio State Univ. Jour., AWW Ass'n, July.

### Cooperation of Industries To Conserve Use of Ground Water

Two illustrations are given of the use by an industry of water which had previously been used by another, thus halving the amount which otherwise would have been withdrawn from the ground supply. At Champaign, Ill., The I. C. Railroad and a Swift & Co. soybean plant, 1,000 ft. apart, each had an insufficient well supply. The latter used most of its supply for cooling. By contract, the railroad pumps its supply to the Swift plant, and after use there, it is returned to the railroad, supplemented by water from its own supply. In the other case, a soybean plant at Taylorville, Ill. pumps about 75% of its supply, after use there, to a nearby paper mill to supplement its supply.

"Industries Practice Water Conservation by Multiple Use of Supply Systems." By J. B. Stall, of Illinois State Water Survey. Water Works Engineering, August.

### Automation at Los Angeles and Maryland

At Los Angeles, Calif. the distribution of water to an area of 453 sq. mi. with elevations up to 2440 ft.



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# WATER USE UP 75% BY 1975!

Competition for water mounts  
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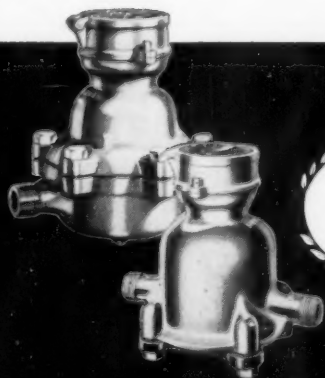
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requires the use of 53 secondary pumping plants. About 90% of these are fully automatic in operation, varying in size from 10 to 600 hp. Their operation for 10 years past has been most satisfactory, better than that of the manual plants. The saving in labor cost has been over \$15,000 per plant per year.

The Washington Suburban Sanitary District covers an area of 302 sq. mi. in Maryland. To supply this area, water is pumped to a filtration plant at elevation 425. Booster stations pump the filter plant effluent to higher elevations, some of them 660

ft. To reduce the pressures at lower elevations, pressure reducers have been installed. All of these are operated automatically or by remote control from the main office.

"Automatic and Centralized Control of Outlying Water Pumping Stations." *Water Works Engineering*, August.

#### Controlling Pressures In a Long Distribution System

To supply water to rural areas in Great Britain, more than 300 miles of 1, 2 and 3-in. mains have been laid. This resulted in pressures vary-

ing from 300 ft. at midnight to 10 ft. during the day. To replace these at once with a larger pipe is considered to be impracticable financially. What the engineers of one area have done to ameliorate this condition is described in this article.

"Pressure Reducing Valve Control in Distribution Systems." By Delwyn G. Davies. *Water and Water Engineering*, July.

#### Water Used in Air Conditioning

Installations for air conditioning are increasing rapidly in number in communities of all sizes, in both residences and commercial buildings. It is becoming necessary for water utilities to require that only types that conserve water be supplied. The writer estimates that, if non-conservative conditioners be used, business establishments would use twenty times their normal consumption for this purpose, basing this on investigations made at Trenton, Mo. He recommends that ordinances be adopted that provide for a demand rate of charge based on winter or yearly usage; penalties, and the power to discontinue water service in cases of violation of the ordinance; and a system of inspection and issuance of permits revocable by the superintendent. Separate meters and rates for non-conservative conditioners has been tried in Trenton.

"Air Conditioning Brings Water Problems." By Lester D. Kempton, Supt. of Utilities. *PUBLIC WORKS*, September.

#### Other Articles

"Slow Sand Filter Plant Converted Into Modern Rapid Sand System" at Indianapolis, during 1951-1953. Six slow filters changed to mixing and settling basins. By R. J. Becker, Supt., and M. P. Crabill, Mgr. *Water Works Engineering*, August.


"Chicago Starts New Fluoridation Plant." Digest of report by John R. Baylis, Eng. of Water Purification. *Water Works Engineering*, August.

"Regulated Missouri River Basin Assures Dependable Water Supplies" for the St. Louis area. *Water Works Engineering*, August.

"Solving Corrosion Problems by Chemical Treatment and Control." Operators' Manual on Lab. Control. By F. W. Gilcreas, Prof. of San., Univ. of Florida. *Water Works Engineering*, August.

"Uniform Water Practice Standards." Discussion on advantages and disadvantages at AWWA Convention. *Water Works Engineering*, August.

"Why Not Use Water Demand Charge for Air Conditioning Requirements?" The writer considers such charge the only sensible solution. By



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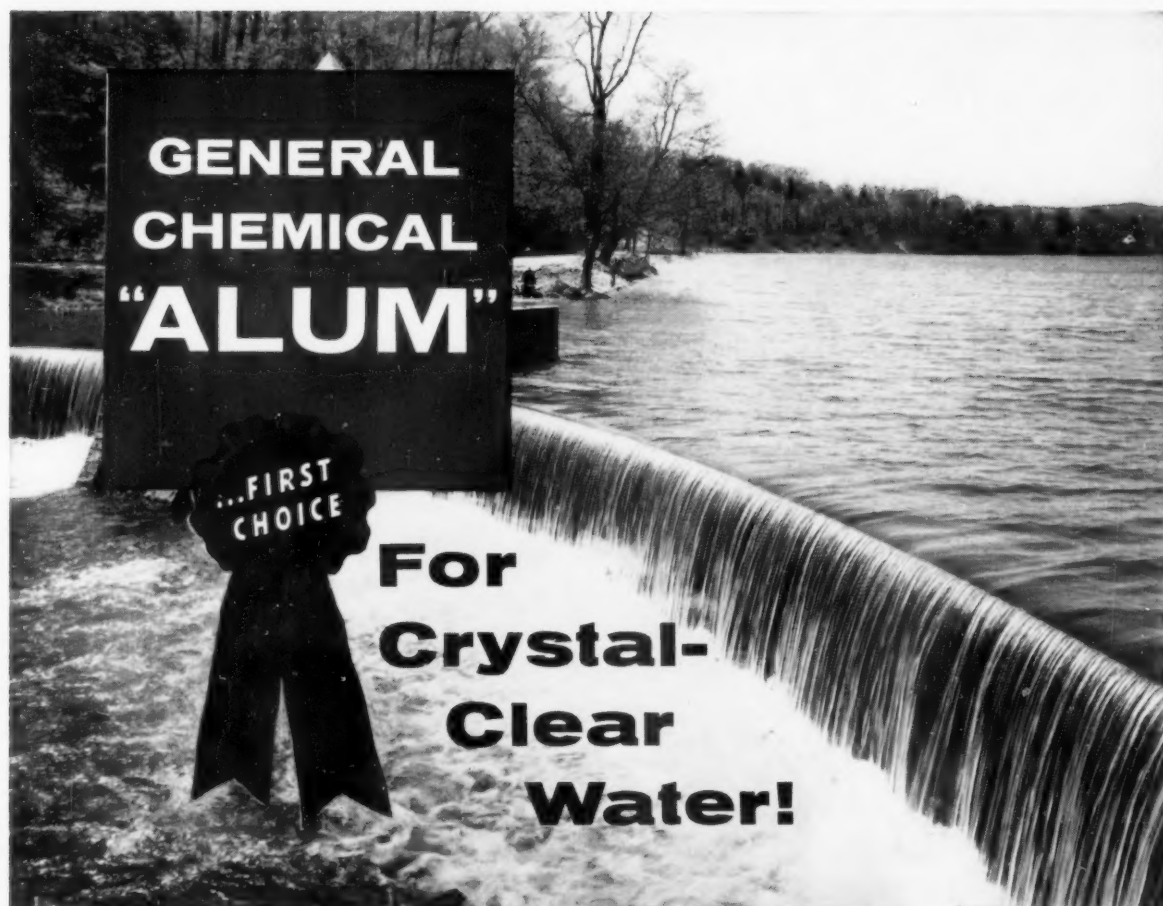
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PUBLIC WORKS for October, 1956



Frank C. Amsbury, Jr., V. P. Long Island Water Corporation. Water Works Engineering, August.

"Public Water Supply and the Future." By Paul Weir, Gen. Mgr., Water Works, Atlanta, Ga. Jour., AWW Ass'n, July.

"Futility of Barriers in the San Francisco Bay System." by Raymond A. Hill, Cons. Eng. Jour., AWW Ass'n, July.

"Method for Collecting and Filtering Water Samples Without Airborne Contamination." By Norvel M. McClung, Prof. of Botany, Univ. of Kansas. Jour., AWW Ass'n, July.

"Acid Pretreatment in Aluminum and Fluoride Determinations." By William

R. Jones and Bert W. Clark, both chemist and bacteriologist, Water Dept., Minneapolis. Jour., AWW Ass'n, July.

"Filtration." Revision of Chapt. 11, Water Quality and Treatment. Jour., AWW Ass'n, July.

"Development and Use of Specifications for Cast-Iron Pressure Pipe and Fittings." By Jack W. Mackay, of Am. Cast Iron Pipe Co. Jour., AWW Ass'n, July.

"Tentative Standard Specifications for Dimensions for Steel Water Pipe Fittings." Jour., AWW Ass'n, July.

"Leak Detection Program Saves 390 MGD" in Chicago, using the dye test. Public Works, September.

"The Tottiford Filter Plant Extension of the Torquay Corporation Waterworks," completed in May, 1956. Water and Water Engineering (England), July.

"A Second Plant for Bloomington, Ill.," including a second source of supply. By Sydney L. Zeid, Consulting Eng. American City, August.

• • •

### Water Consumption Sets New Records

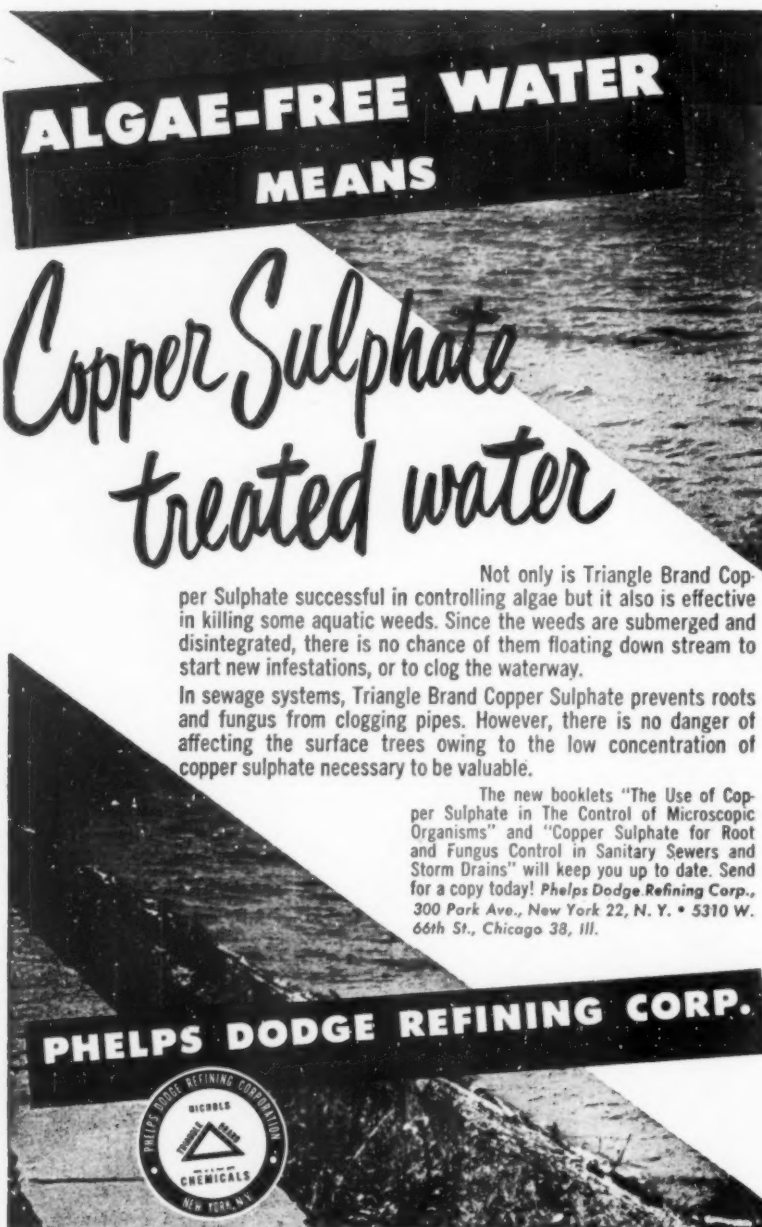
Midland, Texas, residents on June 15, 1956, established a new record for water consumption with a total of 15,710,000 gallons used in a single day or an average of 350 gallons per capita. The average daily consumption in June of 13,475,000 gallons also set a new record. The high water usage caused several low pressure areas in the city and as a result citizens, on June 7, were asked to water their lawns on alternate days. Under the alternate watering plan, residences with even numbers water their lawns on even calendar days and residences with odd number water on odd calendar days. A total of 97 new accounts were added in June, bringing the total number of water customers to 12,077. This compares with the 10,934 customers at the same time last year. This material appeared in the Midland Monthly Report.

• • •

### World's Longest Overwater Bridge

Late in the summer, the first vehicle rolled over the smooth, new three-lane Lake Pontchartrain Causeway, New Orleans, the longest overwater bridge in the world. Estimated traffic is 1,278,000 vehicles per year on the major artery of the Greater New Orleans Expressway which is a \$51-million network of highways connecting with major roads to Texas and points north, northeast and west, and to the Gulf cities.

Components of the Causeway were precast and prestressed in steel forms at the plant site. They were then assembled, loaded on barges and towed to construction points on the lake. Mass production techniques scheduled construction in three phases: 1) Barge-rigged units drove 96-foot cylindrical concrete piles, two at a time; 2) Another unit then sets a steel-reinforced cap on the two piles and seals it with concrete; 3) Completing the superstructure included placing a 56-foot deck section atop



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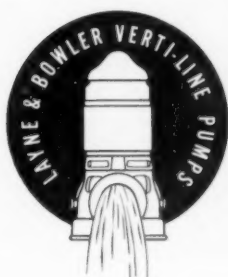
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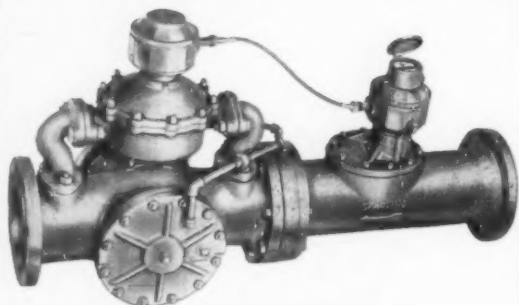
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Mounting Flange	Steel or C. I.
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Pump Bowls	Class 30 C. I.
Pump Shaft	Type 416 Stainless Steel
Bowl Bushing, Upper	Bronze SAE 40
Bowl Bushing, Lower	Neoprene
Other Shaft Bushings	Bronze SAE 40
Impellers	Bronze SAE 40
Impeller Collet	Steel AISI B1113
Shaft Coupling	Type 416 Stainless Steel
Motor Adapter	Class 30 C. I.
Submarine Power Cable	Versatol Geoprene
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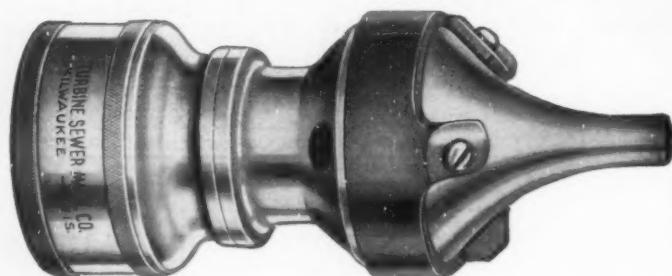


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the piles and cap, bringing it to the final road grade. Aluminum hand-railing, expansion plates and electrical wiring were added.

The roadway is 28 ft. wide and provides sufficient width for three vehicles to pass abreast. The bridge consists of 2,246 spans with three raised humps to provide clearance for small craft and two double-leaf bascule bridges for larger craft.

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### Trickling Filter Treatment Plant Calculator

A calculator designed to speed the process of determining tank sizes for sewage treatment, and for doing otherwise laborious design calculation has been devised by L. E. Livingston, Jr., from down in Texas. He sent one to your editor who finds it quick and useful. The clarifier computations are simple: Set the upflow rate desired and read opposite the rate of flow the tank diameter and opposite the detention period the sidewater depth.

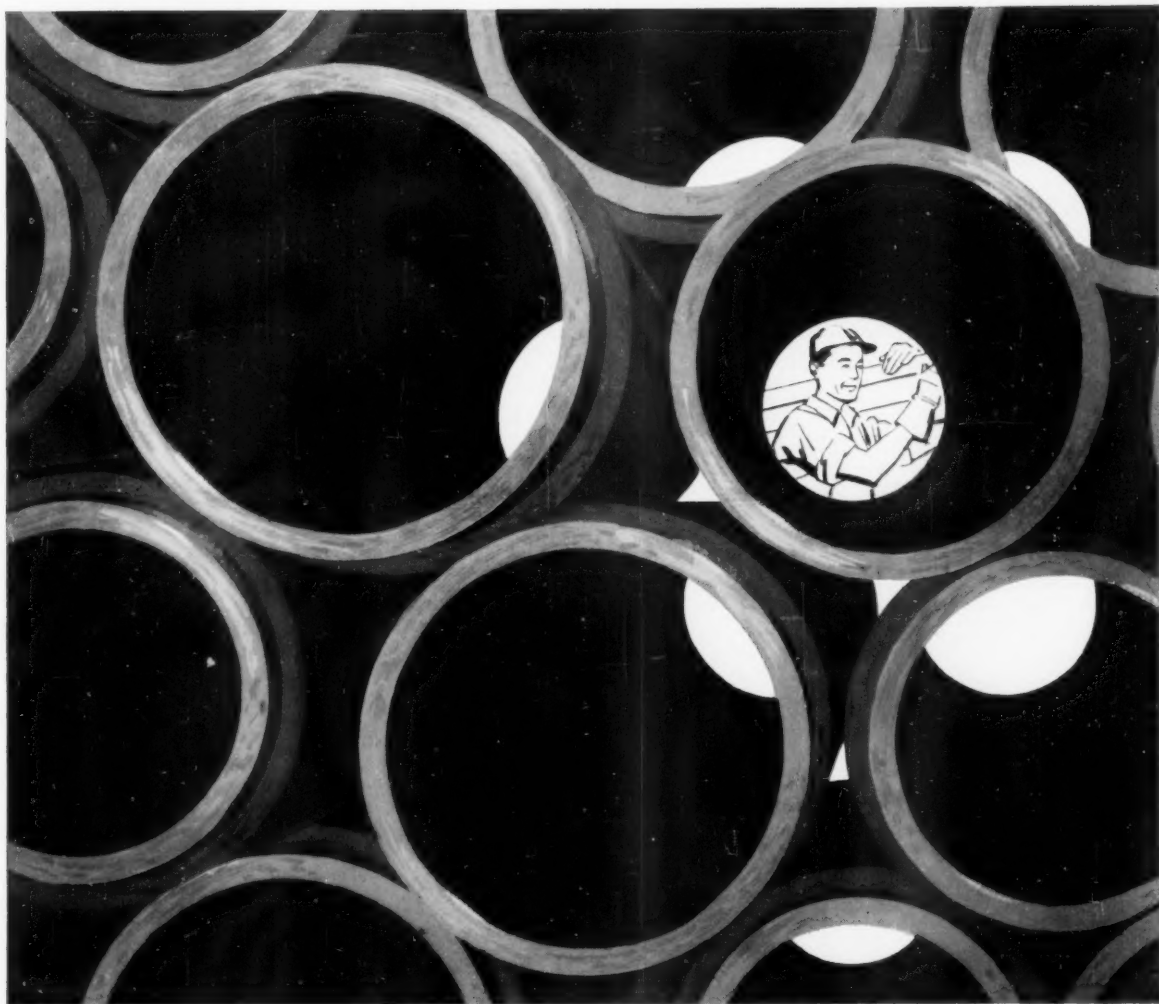
For digester calculations, knowing the volume desired, the calculator shows required diameter for any depth. Allowance must be made for the cone at the bottom. In computing trickling filter data, the applied BOD loading in pounds per day is set at the BOD loading in diameter is shown on the scale opposite the depths of media and volume of media is indicated by an index line. A further refinement shows the surface application rate.

This useful and ingenious card-board calculator is one of many nomographs and calculators devised by Lou, Jr., son of Lou Livingston, well and most favorably known throughout Texas.

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### Street Opening and Obstruction Deposits

Whenever it is necessary to make an opening in a street or alley pavement, or to use a street for storage of material, a deposit is required from those making the opening or using the street. In the case of street openings, the cost of replacing the backfilling and the pavement is charged to the party making the opening. When materials are placed on the street or alley, a monthly rental charge is made and this, if the Street Department is put to any expense, is charged to the contractor and deducted from the deposit. These regulations appeared in the Oak Ridge, Illinois, 1955 Annual Report.



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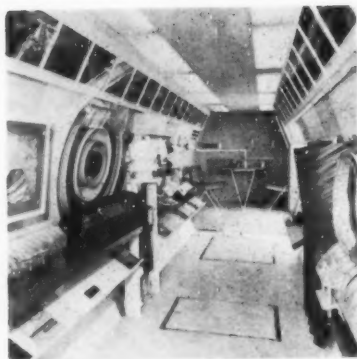


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# "STEELMOBILE" displays

## Armco Construction Products



● "Steelmobile" contains full scale exhibits of road construction products.

A UNIQUE christening took place August 28 at Middletown, Ohio, when a traveling exhibit known as the Armco "Steelmobile" was presented to newspaper and trade magazine editors at ceremonies held by the Armco Drainage & Metal Products, Inc.

The "Steelmobile" is a huge corrugated steel pipe mounted on trailer wheels and pulled by a conventional tractor. The trailer houses sixteen full scale exhibits of Armco construction products and services. It is elliptically shaped of curved highly polished stainless steel plates and cost more than \$50,000 and about nine months to build. The unit is 35 feet long, 8 feet wide through the barrel or body and 12 feet high. All seams are waterproofed and the trailer weighs about 22,000 pounds, including the exhibit.

There is a year-round air-conditioning unit. A 16 mm sound movie projector is provided, together with a projector for showing color slides of Armco products.

On display inside the "Steelmobile" are Armco products including water supply and sewer pipes,

drainage pipe, tunnel liner plate, water control gates, highway guard rail, foundation piling, retaining walls and pre-fabricated steel buildings. These items are shown in individual displays lining each side of a five-foot aisle. Above the displays are full color transparent pictures of typical installations. Actual installation conditions are simulated in these realistic displays, so the viewer can picture the ways in which he can use the products. There is a conference area in front where visitors can ask questions, get detailed information and discuss their problems and needs with Armco representatives.

The "Steelmobile" is now starting on a 50,000-mile, 16-month tour of United States cities and border areas of Canada to show engineers and municipal officials the progress that Armco Drainage & Metal Products, Inc., has made in the development of metal drainage pipe and other steel products. Armco operates more than 50 fabricating plants from coast to coast and has sales offices in most principal cities.



● STAINLESS steel sewer pipe on wheels will travel 50,000 miles in a 16-month tour of U. S. cities. Public works officials will be invited to visit the unique displays.

## Garbage Eliminators For Outlying Municipal Areas

Garbage eliminators are being tested as possible low-cost solutions to garbage problems in outlying municipal areas by the Muskegon, Michigan, Fire Department. Firemen will deposit garbage from all meals prepared at the stations in Bardomatic units and will keep a check on results. These eliminators utilize bacterial action to dissolve all garbage. Approximately 85 percent of the refuse becomes liquids which seep away in the ground, leaving the remainder as compost. No plumbing or power is required and it is said there are no fumes of any kind.

## Recommends Refuse Disposal Plan

Consulting engineers have recommended that Denver, Colo., undertake the combined collection of garbage and trash with disposal at a city-operated sanitary land fill. At the present time the city collects trash, and a private contractor handles garbage collections. The capital outlay for equipment needed to put the program into effect would be \$2,382,500, and the annual operating cost by 1965 would be \$1,788,000.

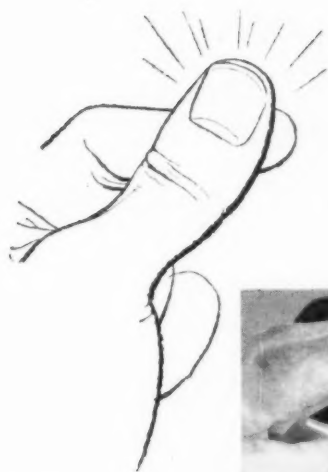
## Demolishing Dangerous Buildings

Throughout the City of Chicago, the number of overage, worn out and dangerous structures which should be torn down grows steadily. In the interest of public safety, the City institutes demolition proceedings against structures which are so inherently dangerous as to constitute a public nuisance. Legislation passed in 1953 gave the City important new powers to deal with the problem of financing public demolition. Under this legislation, the City is authorized to attach a lien on property it tears down or repairs pursuant to a court order. Other new legislation empowers the City to require owners of properties which are in violation of the Building Code to bring their buildings within the minimum standards of the Code or be faced with contempt action. The new legislation also contains provisions for the expediting of such suits in the courts.

The Chicago Law Department, during the past year, utilized these new powers in eight demolition cases. It is expected that these procedures will be utilized in greater number during the coming year.

PUBLIC WORKS for October, 1956



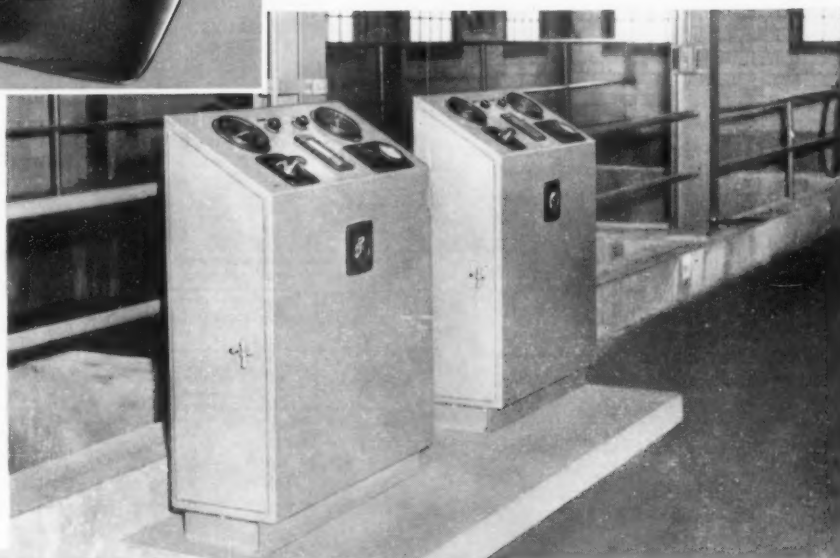


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Two of four Foxboro Operating Tables which give operators complete control of four rapid sand filters in boiler-water treatment plant of Westvaco Chlor-Alkali Division, Food Machinery & Chemical Corporation, South Charleston, W. Va. In addition to operating table instrumentation, Foxboro panel instruments (not shown), control and record wash water level; record total effluent rate, loss-of-head, clear well level, and backwash rate. Consulting engineer: Shepard T. Powell, Baltimore, Md.



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FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

# SUMMARY OF INFORMATION: Capital Investment Values of Public Sewerage Systems

Prepared by Walter L. Picton, Deputy Director, and A. T. Levie, Water and Sewerage Industry and Utilities Division, U. S. Department of Commerce.

**PUBLIC SEWERAGE** systems, like public water supplies, comprise one of the Nation's largest and most essential industries. The American pattern of metropolitan industrial development could not exist without these indispensable facilities for the collection, treatment, and disposal of wastes. The replacement value of these facilities—estimated at \$19.9 billion at the end of 1955—must be increased to an estimated \$34 billion by the end of 1975 (expressed in constant 1954 dollars) to provide adequate service to the growing population.

In this study, an attempt has been made to illustrate the growth in population served, annual construction, and annual accumulated investment values. Inter-relations and correlations with other statistics have been used to develop estimates for the national totals. Reported statistics were revised to produce a realistic picture of the magnitude of the sewerage works industry.

Projections to 1975 are presented. These projections are considered conservative with respect to population served and requirements for service but, with respect to annual construction and accumulated investment value, they present the most optimistic picture considered to be within the range of realism. This study therefore represents a goal for the sewerage works industry and is not necessarily a prediction of what actually will be accomplished.

## Basis of Estimates

**Population.**—Bureau of the Census data on growth of population residing in the Continental United States were used. From these data, an estimate was made of the gradually increasing percentage of the national population grouped in communities, including unincorporated and suburban fringe areas. These estimates were compared with estimates of popula-

tion served by public sewerage systems in certain years to show the trend of total population served from 1900 to 1955.

**Construction.**—New construction was put in place each year to provide additional systems, extensions of existing systems to new areas, treatment facilities, and facilities to offset those which had served their useful life. In this study, previously published data on such construction were revised upward to include more nearly adequate allowances for force account construction; material and equipment purchased directly; construction by privately

owned utilities; sewer mains that were installed by real estate developers; and other undercoverage.

During the period covered by this study, there has been a gradual but large decline in the value of the construction dollar. Summation of annual construction for past years, if available, would not properly indicate the present value of the investment. Therefore, the estimated historical capital investment is converted into constant dollars in line with 1954 construction costs, permitting a good indication of the present value of public sewerage system investment and a better

Chart 1. ESTIMATED ANNUAL CONSTRUCTION

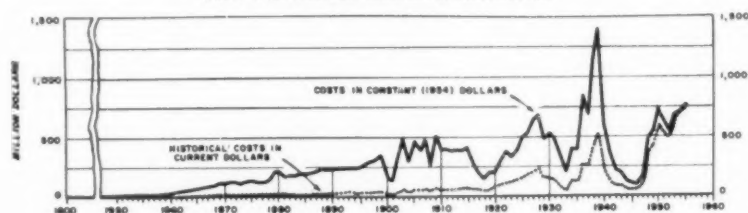


Chart 2. ESTIMATED REPLACEMENT VALUE IN CONSTANT (1954) DOLLARS IN RELATION TO POPULATION SERVED

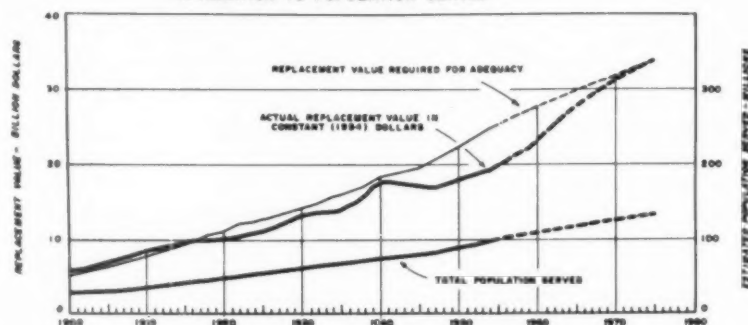
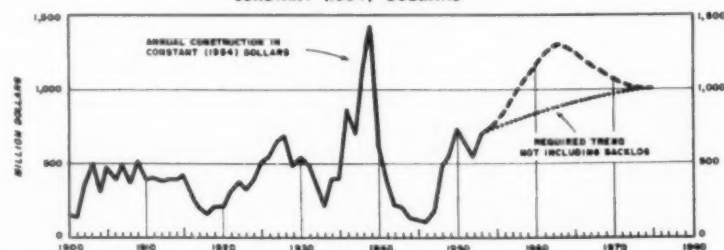


Chart 3. ESTIMATED ANNUAL CONSTRUCTION COSTS IN CONSTANT (1954) DOLLARS



guide for charting the magnitude of future investment needs, which are also presented in constant 1954 dollars.

For this conversion, beginning with 1913, the *Engineering News-Record* Construction Cost Index was used as more nearly representing sewerage works construction costs than any other well-known index. Prior to 1913, the wholesale price index of building materials was used. It is believed that these produce a representative conversion.

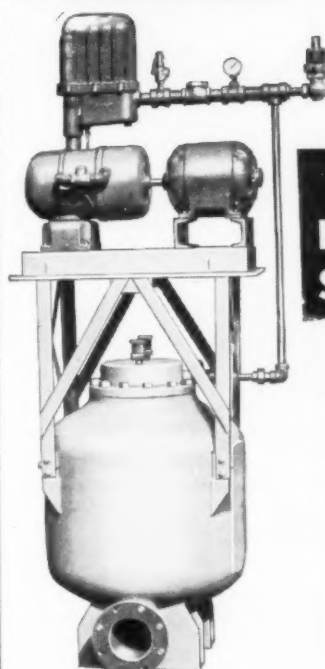
**Loss of Useful Life.**—Allowance for loss of useful life must take into account variations in length of useful life and technical obsolescence in types of facilities, such as collection lines, trunk sewers, pumping stations and force mains; interceptors and storm water bypass facilities; and treatment plants, outfall sewers, and tide gates. Considering this variation and the present treatment requirements, compared with facilities provided in past years, it is believed that the allowance for loss of useful life which must be restored by construction should be in the neighborhood of 1.5 percent applied to the residual value in constant dollars on a declining-balance basis. After this deduction, the remaining value in constant dollars is estimated to have been \$19.9 billion at the end of 1955.

**Limitations.**—Since statistics on the estimated annual volume of sewerage works construction prior to 1915 are not available, the growth could be approximated only by using spot estimates of the number of systems in operation and the number of people served.

**Capital Investment.**—Replacement value of public sewerage system facilities expressed in constant 1954 dollars increased from \$17.5 billion in 1940 to \$19.9 billion in 1955. However, due to the lack of adequate annual construction, the estimated per capita replacement value in 1954 constant dollars declined from \$237 in 1940 to \$201 in 1955. During the period from 1940 to 1955, the raising of standards for adequate sewage treatment progressed at a greater rate than in the previous 40 years. The estimated per capita investment required for adequate service, according to the new standards, increased from \$248 in 1940 to \$257 in 1955.

Thus, the 1955 replacement value of public sewerage systems adequate to provide this service would have been \$25.7 billion in constant 1954 dollars, compared with the estimated actual value in-place of \$19.9 billion. The difference between these figures, \$5.8 billion, represents the backlog of construction needed to provide

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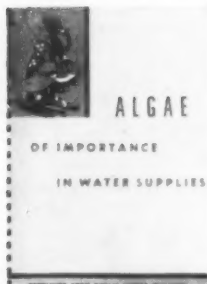
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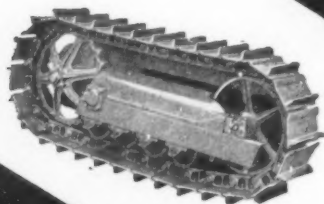
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adequate sewerage facilities according to present standards.

## Projections To 1975

For projections to 1975, a level was used slightly higher than the Bureau of the Census "C" projection, ranging from about 0.8 percent in 1960 to 1.0 percent in 1975. Compared with the rate of population increase in the past 20 years, or more particularly in the past 15 years, such a projection appears reasonably conservative.

Assuming that the percentage of total population located in communities will continue to increase, community population will grow from 126.2 million at the end of 1955 to an estimated 163.0 million in 1975, the increase representing nearly 90 percent of the total population increase. The rate of increase would be only slightly higher than that of 1940-1955 and more recently of 1950-1955, when about 85 percent of the population increase located in communities.

It is estimated that in 1940 about 75.9 percent of the community population was served by public sewerage systems. This percentage grew to about 79.2 percent in 1955 and is estimated to reach 82.2 percent by 1975. This means that the increase in population served should be almost as large as the increase in community population. It follows that during the 20 years from 1955 to 1975, the population served by public sewerage systems should increase from 100 million to at least 134 million, an increase equivalent to about 81 percent of the total population increase.

**Capital Investment.**—In projecting the per capita investment required in facilities for collection, treatment and disposal, capital investment and annual construction were estimated on the basis of the needs of the existing population, recognizing that only a portion of the total at any particular time would be provided with excess capacity for future growth.

During the past year, the backlog of needs has been estimated, and theoretical programs outlined to eliminate the backlog in 5 or 10 years. In dealing with sewerage utilities, over 90 percent of which are publicly owned and operated, it could not be assumed that a large increase in the annual volume of construction could get under way in a short period of time. Years are required for designing, estimating, authorizing, financing, advertising, and executing contracts. This study, therefore, visualizes the elimination of the backlog of needed construction.



tion over a period of 20 years as being the most optimistic accomplishment that should be anticipated.

The annual volume of sewerage construction put in place each year was projected at the maximum annual rate of increase considered practicable until 1963, with a gradual return to normal requirements in 1974. The annual volume of construction is estimated to be sufficient to eliminate the backlog of needed construction, to offset loss of useful life of facilities, and to increase capacities and facilities to provide for growth in population served and meet adequate standards of sewage treatment.

Projection is made on the basis of constant 1954 dollars. Readjustment in the annual volume will, therefore, be required in accordance with changes in the purchasing power of the construction dollar in the future years.

Needs of the projected program for 1955-1957, in billions of 1954 dollars, is summarized as follows:

To eliminate deficiencies	\$5.8
To offset depreciation	8.1
For growth	8.3

Total	\$22.2
-------	--------

Adding the projected volume of annual construction to the accumulated investment value and deducting allowances for loss of useful life, the replacement value of public sewerage systems should grow from \$19.9 billion at the end of 1955 to \$34 billion at the end of 1975.

### Calcium Chloride for Speeding Curing of Concrete Streets

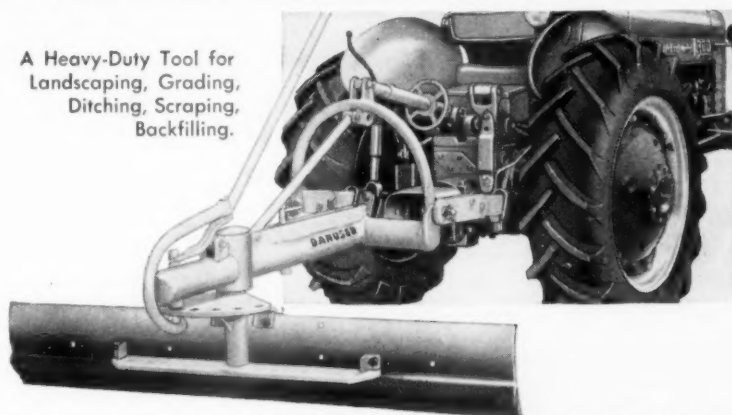
The use of calcium chloride to accelerate the setting of concrete is standard practice in San Francisco for all pavements and parking strips to speed up the use of the roadway for movement of traffic. However, on steep grades, where stiff mixes are required, the use of calcium chloride has been found to be undesirable. It sets the surface too fast and the concrete cannot be properly placed and finished.

### Report of the Florida Turnpike

Engineers estimate that, with normal weather conditions, the opening date of the Florida State Turnpike will be January 1, 1957. Actual construction cost of the project will show a saving of approximately \$8.4 million dollars or 18 percent of the originally estimated \$45.9 million dollars. The Turnpike, about 110 miles long runs from just north of Miami to Fort Pierce.

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## PUBLIC WORKS DIGESTS

# THE INDUSTRIAL WASTE DIGEST

### Windsor-Detroit Atmospheric Pollution Studies

As a part of the studies of atmospheric pollution in the Windsor-Detroit area, an investigation was undertaken to identify individual condensed ring polycyclic aromatic hydrocarbons, in view of their importance as carcinogens and possible association with lung cancer. Samples were collected on fiber glass filters or from the air intake of an air conditioning system located in an area of high pollution. The samples were then extracted with chloroform and the extract fractionated by chromatographic adsorption analysis. After elution of the chromatographic column with cyclohexane and benzene, the eluate was subjected to ultraviolet absorption techniques. The polynuclear aromatic hydrocarbons identified were pyrene, fluoranthene, benz(a)anthracene, chrysene, and benzo(e)-pyrene.

"Identification of Some Polynuclear Aromatic Hydrocarbons in the Atmosphere." By V. C. Shore and Morris Katz, Defense Research Chemical Laboratories, Ottawa, Canada. *Analytical Chemistry*, September.

### Complete Recovery of Cyanide and Chromium Wastes

The three categories of plating wastes from the Channel Master Corporation plant at Ellenville, N. Y., makers of television antennas, are acid and alkaline rinse and dipping solutions, rinse water from zinc plating (containing zinc and cyanide), and rinse water from the chromic acid dip. In disposal practice, the acid and alkaline wastes are mixed and settled, and the pH adjusted before direct discharge to a stream. Holding tanks are used to afford an opportunity to determine the presence of any cyanide before discharge. The rinse from zinc plating and the chromic acid dip are subjected to closed-circuit treatment for complete recovery of cyanide and chromium. Recovery

of cyanide from the zinc plating rinse is aided by a counter current rinsing process, thus concentrating the waste solution. Recovery is effected by evaporation of the rinse solution until it is equal in concentration to that in the plating tank. The cost of recovery on the basis of sodium cyanide is about equal to the price of new material, but the saving is realized in that treatment for disposal plus the cost of replacing plating materials would be about \$100 per day. Recovery of chromic acid is accomplished by cationic and anionic exchange resins, with the resulting demineralized water reused as rinse water. The monthly saving from chromic

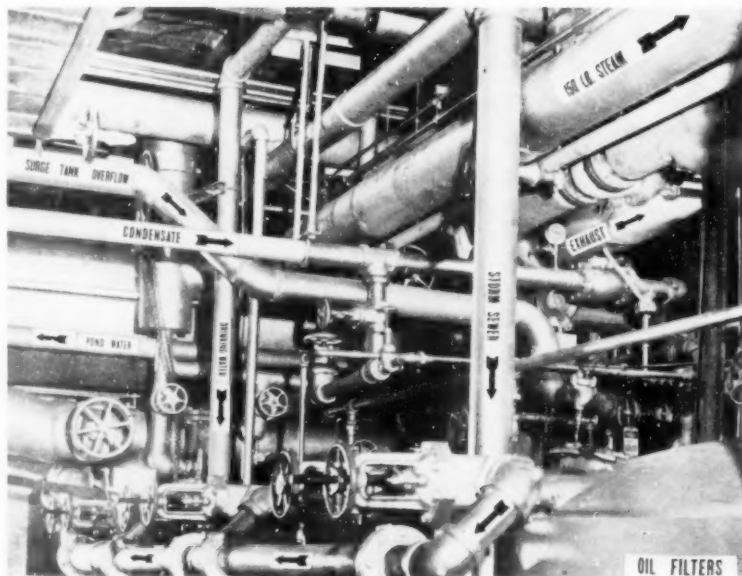
acid recovery is more than \$3000. The cost of the recovery systems and waste disposal equipment amounted to about \$100,000.

"Cyanide and Chromium Recovery from Plating Wastes. By L. Weisberg, Consultant, New York City; E. J. Quinlan, Channel Master Corp., Ellenville, N. Y. *Sewage and Industrial Wastes*, August.

### Toxicity of Heavy Metal Cyanide Complexes

Previous research has indicated that while free cyanide in concentrations well below 0.1 ppm is fatal to fish, cyanide complexes of iron, and nickel are comparatively less

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toxic. This has lead to the proposal that nickel salts be added to free cyanide solutions as a detoxification measure, although there had been indications that dilute solutions of the complexes might be relatively toxic to fish. In working with young fathead minnows, experiments were undertaken to review the toxicity of various heavy metal cyanide complexes under varying conditions of concentration and pH. Zinc and cadmium cyanide complexes were found to be almost completely dissociated in dilute solutions and highly toxic. Free cyanide combined readily with nickel ions to form stable complexes of low toxicity, but dissociation was negligible in dilute solutions only at pH's of 8.0 or better. Consequently, at lower pH, the dilute solutions became more toxic. The addition of nickel salts to cyanide solutions as a waste treatment measure can be effective as long as there is assurance that a high pH can be maintained in the receiving stream. The toxicity of free ionic copper can be markedly reduced by complexing the copper with cyanide. This is similarly true with mixtures of copper and zinc. Complex formation by the addition of ferrous sulfate to very

dilute cyanide solutions prepared with soft water was evidently negligible and of little value in reducing toxicity.

"Some Experiments on the Toxicity of Complex Cyanides to Fish." By Peter Doudoroff, Public Health Service and Oregon State College. *Sewage and Industrial Wastes*, August.

### Trickling Filters for Milk Processing Wastes

The waste products of a polluting quality from the manufacture of powdered milk and condensed skim milk at the Borden Co. plant at Arcade, N. Y., varied in volume from 47,000 gpd. to 183,000 gpd. and in BOD load from 333 to 494 lb. per day. Installation of liquid level controls and alarms prevented excessive peak loads from boil-overs of evaporation equipment. To overcome water pollution problems a high rate trickling filter plant for treatment of the wastes was installed in 1955. Treatment units consisted of a duo-clarifier and a duo-filter, both Dorr-Oliver equipment, in which primary and secondary sedimentation are provided in concentric basins in a single cir-

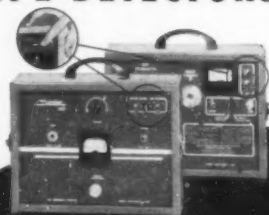
cular structure, and primary and secondary filters in another single structure. The design flow was 175,000 gpd. average and 525,000 gpd. maximum, based on a maximum of 600,000 lb. of milk received per day. The cost was about \$100,000.

A similar plant was installed by Abbotts Dairies at Belleville, Pa., where manufacturing processes consist of milk receiving, canning, pasteurizing and separating; condensing; condensed skim milk drying; and processing butter, cream cheese, and ice cream mix. "Polluted" water volume varied from 17,000 to 27,000 gpd. and BOD from 154 to 202 lb. per day. The plant was designed for an average waste flow of 30,000 gpd. and maximum of 200,000 gpd., and on a basis of 150,000 lb. of milk received per day. The cost was about \$70,000.

Construction costs in each case were about \$200 per pound of BOD capacity. Treatment costs are estimated to be about 7 cents per pound of BOD contained in the plant wastes.

"Trickling Filter Treatment of Wastes at Two Milk Processing Plants." By S. I. Zack, Harrisburg, Pa. *Sewage and Industrial Wastes*, August.

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## Impacts of the Accelerated Highway Program

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**C**URRENT REPORTS indicate that the construction industries, and industries producing construction material, will be able to handle the demands of the accelerated highway program. Those industries which have been operating to full capacity are said to have carefully planned expansion on a long-range level for well over a year.

The increase in demands for construction materials for the new highway program is expected to reach a little over 50 percent for each of the first three years, slowly building up to a maximum in 1960 for some industries and 1962 for others.

**Steel**—Basing their estimates on present-day costs and designs, the Bureau of Public Roads estimates that it will require 420 to 450 tons of steel for every million dollars worth of new roads. The entire 13-year program, including the additional funds to be authorized for regular Federal-aid by future legislation, calls for a total of 48.74 million tons of steel. These estimates do not include related items such as the steel which would go into more trucks, tractors, shovels, drag lines, etc. The demand for structural steel shapes needed for the construction of bridges, viaducts and overpasses will amount to almost 26 million tons.

**Cement**—Officials of the cement industry state that the total productive capacity of the cement industry stood at 194 million barrels in 1954. Highways used 45 million barrels. With a program as big as the one enacted for highways, the need for cement by 1959 for highways alone will reach 107.4 million barrels. By that year, the cement industry expects to be producing well over 370 million barrels.

**Bituminous**—The highway demand for products of these industries, including asphalt, tar and naturalized asphalts will amount to 10.2 million tons per year by 1960. As of now, the annual production of asphalt is 14.6 million tons. Of these, some 2 million tons are used for highways. The Bureau of Mines

estimates that production can easily be increased to over 19 million tons, and, with minor expansion, to over 38 million tons by 1959.

**Aggregates** — (Sand, Gravel, Crushed Stone and Slag) Aggregates have an important part in construction, and the requirements for base and surface courses on high capacity expressways will be extensive. In 1954, 810 million tons of aggregates were produced. Of these, approximately 375 million tons went to highway construction. When the peak years are reached, the demand for highway aggregates will have almost tripled, with an estimated 775 million tons being required. The sand and gravel industry, alone, has doubled its tonnage output since 1946. In 1954, 500 million tons of materials, of which one-third was for highways, were produced. Aerial photogrammetry and other recently developed methods of locating buried natural deposits give promise of the discovery of additional sources in the more critical shortage areas.

**Machinery**—Today, highway construction equipment purchases constitute about a third of the almost \$2 billion annual business of the construction machinery manufacturing industry. The industry's capacity to produce more machinery is ample and will benefit from increased expenditure without any great upheaval or expansion. In 1954, the industry operated between 40 and 60 percent of capacity, and contractors reported that equipment in their hands had at least 33 percent idle capacity. Some machinery companies believe that, once the Government program gets underway, 57,000 units of new road building equipment will be needed for each billion dollars spent for highways. Thus, the volume of highway equipment sales will increase 70 percent in the first year and up to 150 or 200 percent in the second year. Replacement requirements by the fifth year of the expanded Federal highway program are expected to double the demand for increased new equipment.

**Miscellaneous** — Some 330,000 signs or markers were placed on new highways in 1954. For the \$32.9 billion program, without the regular yearly Federal-aid authorizations to be approved at a future time, there will be a need for 26.8 million new signs. A minimum of 5 million gallons of paint will be needed every year for the next two years alone. A total of 9.3 million feet of timber and timber piling will be needed for the 13-year program. Also 1.8 million pounds of dynamite and other types of explosives will be required to construct the new highways contemplated during the program.

### Manpower Data

An evaluation of the effects of increased Federal spending on highways and how it affects the highway construction industries cannot be complete without taking into account manpower which is a principal factor and is responsible for a large portion of the costs of these industries.

Latest figures show that there are between 6,000 and 7,000 highway contractors in this country. In 1955, only 49 percent of their productive capacity was used. This represents a 5.6 percent increase over 46.4 percent reported for 1954, and resulted largely from an increase in the capital outlay for highway construction from \$4.0 billion in 1954 to \$4.6 billion in 1955. Highway contractors say today they can handle \$8.8 billions of business a year and, by 1957, will be able to handle \$14.2 billion, many times the estimated program. To cope with the peak years of the highway program, the contractors will have to expand their training program and develop supervisory personnel, equipment operators and other skills within their organizations.

According to all studies, the most crucial feature in the entire highway program will be finding the engineering talent which may be "more scarce than materials, plants or even money." Steps now being taken or considered to overcome

this program are: A complete reorganization of engineering operations is being considered; the streamlining of certain engineering practices; and the adoption of new and improved methods consistent with sound project control practices. With these measures, officials at the Bureau of Public Roads hope to have four engineers per million dollars of construction.

Of the 2,675,000 unemployed persons in the United States in 1955, 341,000 were from the highway construction field. Many of these would be available for the program. Another source of manpower will come from the growing population. The pool of potential workers from which highway construction industries and contractors can draw is increasing at the rate of 600,000 every year from population gain alone. At the peak of its program, the Bureau of Public Roads estimates a need of 441,000 workers employed 1,600 hours a year (seasonal and weather conditions on highway construction are taken into consideration.)

On an overall basis, increased Federal spending on highways can help create new jobs, increase production and improve the living standards of the country.

A considerable volume of private investments in factories, shops, dwellings and all sorts of service establishments will be stimulated. The impact on retail trade, for instance, will be great. More and more shopping centers will be constructed in areas which are easily accessible to automobiles. Central businesses, which have been increasingly concerned by the trend towards outlying shopping centers, will undoubtedly benefit, too. With better roads, there is no reason why central business facilities in downtown areas should not be able to compete successfully with regional centers.

These new highways, according to all forecasts, will be heavily traveled. By 1971, the United States is expected to have over 92 million automobiles and trucks on the roads. This estimate, based largely on growth and composition of the population with respect to age groups shows that passenger cars alone will increase approximately 1,629,000 per year to a total of 77,182,000 by 1971. Trucks, buses and combinations will increase at the rate of slightly less than 314,000 vehicles per year from the 1957 estimated to a total of 15,318,000 by 1971.

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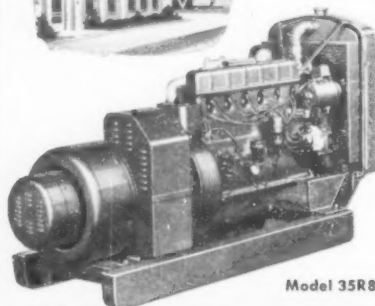
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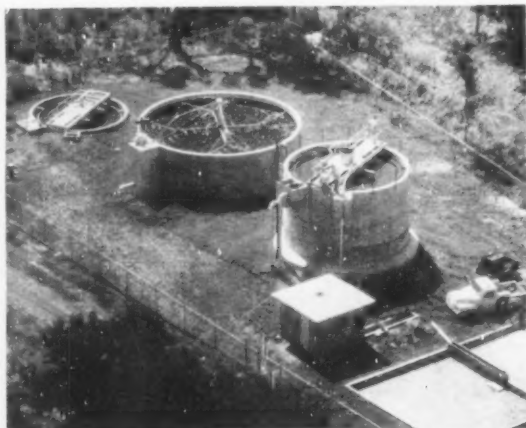
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## BOOKS IN BRIEF

### COMPOSTING ORGANIC WASTES

With a great deal of background material, which covers a wide field of public health, the author discusses briefly the processes involved in the decomposition of organic matter and then proceeds to describe in detail the methods of composting recommended for large towns, for villages and for individual farms. Diagrams and photographs are used to illustrate the methods. There is a chapter on methane recovery from the digestion of manure and night soil. A particularly valuable portion of the text is that relating to the public health phases of disposal of wastes on land. By Harold B. Gotaas, World Health Monograph Series No. 31; 205 pages; 49 figures; Columbia University Press, New York 27, N. Y.; \$5.

### HOW BYPASSES AFFECT BUSINESS

Results of a nationwide survey by the U. S. Chamber of Commerce on highway bypasses (relief routes) are published in a booklet issued by the Chamber. Effects of bypasses on business, property values, traffic volume, pedestrian safety and parking are listed, together with legal aspects, and suggestions for community organization for study and action on the bypass problem as it affects a specific locality. Copies may be had from the Chamber of Commerce of the United States, Washington 6, D. C., for 50¢ each.

### CONCRETE MATERIALS and PRACTICE

This is the second edition of a book by an English author, L. J. Murdock. It refers especially to the use of cements and aggregates and includes admixtures, water-cement ratios, design of mixes, proportioning, mixing and transporting, placement, compaction, curing, cold-weather concreting, finishing, formwork and quality control, inspection and testing. Lightweight concretes and floor finishes are well covered. 355 pages; 230 illustrations; St. Martin's Press, 103 Park Ave., New York 17, N. Y. \$8.50.



#### STATISTICAL ANALYSIS OF HIGHWAY ACCIDENTS

This bulletin contains two papers on the statistical analysis of highway accidents. The first paper, "Accidents Versus Width of Paved Shoulders on California Two-Lane Tangents—1951 and 1952" is based on the statistical analysis of 771 injury accidents which occurred in 1,122 road sections each 1 mile in length. The second paper, "Application of Statistical Quality-Control Techniques to the Analysis of Highway-Accident Data," reviews current techniques for the study of accidents and points out their advantages and disadvantages. The authors then present the development of statistical control techniques, together with the results of a pilot application of these techniques to an actual highway situation. Copies are 75¢ from the Highway Research Board of the National Academy of Sciences, National Research Council, 2101 Constitution, Washington, D.C.

#### LAND ACQUISITION

This publication contains the annual report of the Committee on Land Acquisition and Control of Highway Access and Adjacent Areas, summarizing developments for 1954 in the fields of the committee's interests. It also includes several papers. Two concern the problem of roadside regulation—"Roadside Protection Through Nuisance and Property Law," by J. H. Beuscher, and "The Nebraska State Zoning Agency," by J. Edward Johnson. "Right-of-Way Problems on Urban Expressways," by Edward A. Bielefeld, describes the operations of the Milwaukee County Expressway Commission under recent enabling legislation; and "Highways for New Urban Patterns," by Tracy B. Augur, asks for cooperation between highway designers and state and local planners. Price \$1.80. Copies of Bulletin 113 from Highway Research Board, 2101 Constitution, Washington, D. C.

#### SAMPLING ASPHALT AND MACADAM

However accurate the method of analysis may be, the result of analyzing a sample of a bituminous road material is of little value if the sample is not representative of the material sampled. How big a sample should be and how many samples should be taken are vital questions that should be answered before analyses are undertaken. Obviously

PUBLIC WORKS for October, 1956

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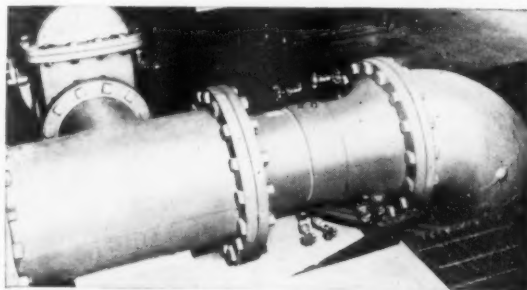
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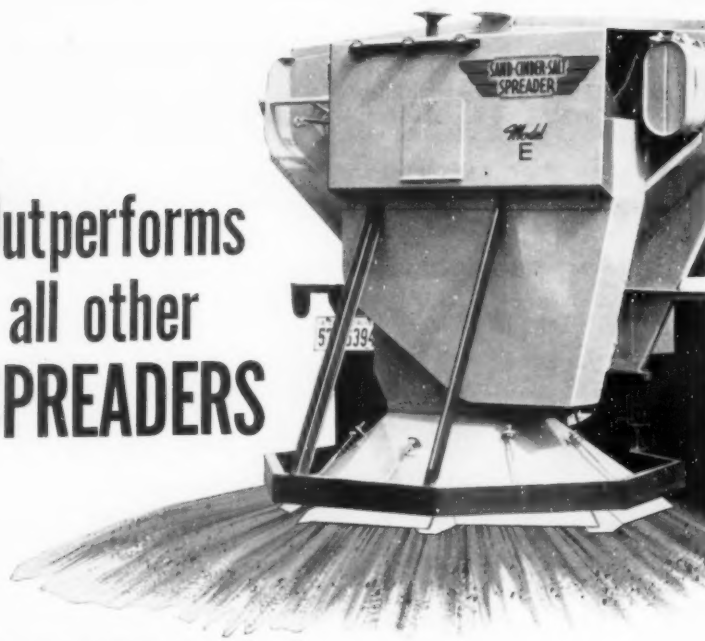


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#### PARKING—

##### A BUSINESSMAN'S APPROACH

Four steps toward easing the parking problems are outlined in a study published by the Chamber of Commerce of the United States. The study suggests: 1) Selection and enforcement of proper time limits on both metered and unmetered curb space; 2) progressive rate schedules in place of fixed charges in carparks and garages; 3) dressing up carparks and garages; 4) educating parkers about available space. This 24-page publication is available from the Transportation and Communication Dept., Chamber of Commerce of the United States, Washington 6, D. C. The price list is 40¢ per copy or three copies for \$1.

#### TALBOTS' RAILWAY TRANSITION SPIRAL

Previously the work of Dr. Arthur N. Talbot, this book has been revised and enlarged by Edward H. Roth, Assistant Engineer, Norfolk and Western Railway, Roanoke, Virginia. The railway transition spiral or curve easement has been widely used by railroads and the methods and principles are readily applied by field and office engineers. Nomenclature; formulas; location and laying out; speed and spiral diagrams; and tables of the transition spiral are a few of the many useful sections. Publishers are J. P. Bell Co., Inc., 816 Main St., Lynchburg, Va. Price per copy \$5.

PUBLIC WORKS for October, 1956

# SERVICE BULLETIN FOR INTERNATIONAL-INDUSTRIAL TRACTORS

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• • •

## Bond Ratings and Prices

(Continued from page 92)

sense, the basic elements which determine quality are common to all types. The intrinsic quality of a bond is appraised on the basis of relative freedom from risk in two areas:

1. The risk that bond quality will be diluted by inordinate increase in debt.
2. The risk that ability to meet maturing bond principal and interest may be impaired under depressed business conditions.

It is hardly conceivable that a municipality would find investors willing to purchase its bonds unless some sort of assurance is offered that the municipality will keep within reasonable limits future borrowings payable from the same source of revenue, or secured by the same credit base. This assurance is developed in a number of ways.

In the case of revenue bonds, future increases in debt customarily are limited by express provisions within the bond contract. Here it may be noted that distinctions are possible between utility revenue bonds secured by the earnings of a going concern and revenue bonds payable from the earnings of a facility which the issuer of the bonds has not yet operated. A long record of capable management may provide significant clues to future financial policies. Where there is no record of management, bond buyers are disposed to presume that future policies will develop on the basis of two premises: (1) That the issuing body will faithfully do all the things it promises to do; (2) that the issuing body eventually will do all the things it reserves the right to do.

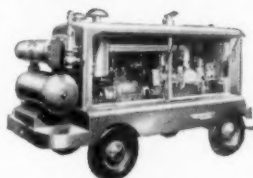
### No Safe Reliance on Debt Limits

Turning to general credit bonds, time was when investors could feel they could rely on legal debt limits to see that a city's debt would not become excessive in relation to its resources. But in several states debt



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limits have been relaxed in recent years; in other states, with increasing frequency, public works are coming to be financed by special authorities or special purpose taxing districts rather than by the municipality directly. Whether added bonding powers available to communities today, as compared with a generation ago, have resulted from more liberal debt limits or from borrowings arranged outside restrictive debt limits, bond buyers have come to realize that they can place no sure reliance upon debt limits to keep debt within reasonable bounds.

Assurance that there will be no worrisome increases in debt is only to be found in the happy combination of modest debt and governmental facilities which are adequate for immediate and prospective needs. If debt is high, credit is apt to be poor; but even if debt is low, credit is not apt to be high where a community possesses a grossly inadequate plant or badly deteriorated facilities. Either of these situations holds a strong suggestion that much debt will be incurred as time goes on.

The second point on which the investor wants assurance is ability to pay. In this regard, he is not concerned with present ability alone; there must be something left in re-

serve to take care of a rainy day.

The bond buyer does not think of ability-to-pay only in terms of the legal ability to raise the tax rate as needs require. The debt service portion of the budget may be amply secured under the letter of the law, but the whole budget structure of a community must be healthy to assure a high credit standing. Because this is true where the tax rate is legally unlimited, it is doubly true in those instances where the tax rate is limited by law.

Whether the tax rate is limited or unlimited, credit is not apt to be of a high order where a city already is relying heavily upon non-property tax revenues and, at the same time, is taxing property close to the limits prescribed by law or close to practical economic or political limits.

Tax rates and sources of revenue are important, but the investor's concept of ability-to-pay is primarily a matter of economics. Just as one cannot drain blood from a turnip, so one cannot collect taxes in a community wholly lacking in community income, reserve wealth, or both.

In passing, it may be noted that a credit base of a sort seems to be present in some degree in about any community one might name. The

bond buyer's concern is the matter of degree. The accident of geography has much to do with credit, for the largest part of community income is derived either from productive enterprises or from services and trade.

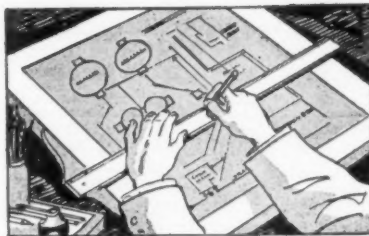
If one could ignore the part local management plays in shaping credit, credit analysis would be a relatively simple matter indeed. Thus, among agricultural areas, best credits typically are found in areas where the soil is deep, fertile and well watered; sub-marginal farm land typically produces poorer credits. Similar relationships can be drawn between a city's credit and its industrial and commercial attributes.

### The Role of Management

Economic geography represents a very real and very basic element in public credit. Beyond this, the several roles played by management add leavening and seasoning to the credit cake. One role is the exercise of the legislative function: the formulation of plans and policies to be followed in the future. Another role is the exercise of the executive function which is primarily concerned with administrative techniques. Then there are some areas where these two roles overlap or merge in part. Brief reference may be made to three of these: economic



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development, public relations and debt administration.

Credit is very importantly related to economic ability to pay. If a city is to sustain or even enhance its credit, it must develop and display a governmental environment attractive to new businesses and/or new residents who possess a well developed social conscience and who are willing to carry a fair share of community responsibilities. The community is heading for trouble in the long run when sole attraction to business is an opportunity for exploitation, or when sole attraction to new residents is a low tax rate. A community attracts desirable residential and business increments in a number of ways. One prime essential is a reputation for fair, equitable and equalized property assessments. A stable budget and tax rate are another. The presence of adequate community facilities is a third, and it must be emphasized that adequate facilities are the end product of careful, comprehensive, capital planning. Last, but not least, is a reputation not so much for a low tax rate as for governmental economy, the result of careful screening of spending proposals, not merely the result of a policy of cost deferment.

Perhaps a high order of credit can be produced without attention to public relations, but a good job in this field certainly helps to influence investor opinion favorably. In essence, public relations are concerned with keeping citizens alert, informed and actively participating in local affairs, and they are also concerned with maintaining a wholesome relation with bondholders. This is closely related to reporting. Management is appraised by how well its reports tell its story, as well as by the story itself. Investors are deeply concerned about the availability of authoritative information, for when credit is extended beyond local, informal arrangements, it depends on facts and figures.

Finally, a city's credit is importantly influenced by its record in the area of debt policy and administration. The key to good debt administration is the willingness to face up to responsibilities, to meet today's costs today. Capable, aggressive debt administration is a certain foolproof means of assuring long-range economy. Unfortunately, it rarely produces quick, demonstrable results, and this failure to produce quickly too often induces shortsighted, penny-wise and pound-foolish policies.

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rates for any necessary borrowing. Beyond this, an aggressive debt retirement policy means sharply lower total interest costs, a great saving in the long run, as interest is paid for a shorter span of time and usually at lower rates than is the case with protracted maturities. Most important of all perhaps, reasonably rapid debt retirement means that the community will not be asked to pay debts incurred for facilities which have outlived their usefulness; finally, it means that borrowing capacity within safe limits is recaptured quickly for reuse as changing times dictate.

 **How Ratings Help the City**

Of course, no fee is sought or accepted from the municipality whose bonds are rated by Moody's. Our income is derived exclusively from charges to investors who subscribe to our publications in which the ratings appear or to whom we render other services. In one sense, of course, there is imposed upon the municipality whose bonds are rated the moral obligation to supply from time to time financial and related information so that the rating may be reviewed regularly and kept thoroughly in accord with changing circumstances.

If a municipality's debt exceeds the minimum limit of \$600,000, mentioned above, it will be amply repaid for seeing that its bonds are rated. It is unfortunate, but true, that investors pay a lower price for unrated bonds than they are willing to pay for rated securities of equivalent safety. So many investors have come to rely on ratings as a guide in bond selection that rated obligations, as a group, enjoy much wider marketability than unrated issues, as a group. It is true that there are several prominent bond issues (for example, many of the multi-million dollar turnpike revenue bonds) which are widely held by investors and are actively traded although they are not rated pending the completion of construction and the development of actual earnings experience. But as regards city, county and school district bonds, unrated issues typically can be sold only in the vicinity of the issuing unit where investors know the area; rated municipal and school bonds, on the other hand, frequently are purchased simply on the basis of the rating by investors far away, who know little or nothing of the area. Thus, having a rating tends to increase the demand for a particular credit; and in turn, increased demand reduces the interest rate a city must pay.



# PUBLIC WORKS EQUIPMENT NEWS

Published Monthly

October, 1956

## Pipe Pusher Features One-Man Operation

The "Pow-r Mole" is a compact new device for pushing water and gas lines and pulling copper or lead lines up to 3 inches in diameter under roads, streets, sidewalks or lawns. It replaces the bucket on any standard tractor-mounted hydraulic backhoe. One man can dig the approach trenches, attach the unit, insert the pipe sections and operate the tractor. Since the Pow-r Mole utilizes the power of the tractor to push or pull pipe, and down pressure on the backhoe boom stabilizes the unit while in operation, no other equipment, as air compressors, jack hammers or winches, is needed. For more information write Pow-r Devices, Inc., Dept. 161, Clarence Center Road, Clarence Center, N. Y., or circle No. 10-1 on the reply card.



Device is used for pushing water lines

## Post Hole Digger With Interchangeable Heads

A new post hole digger, especially suited for installing guard rails, sign and similar posts is announced by Roper. The digger is equipped with a series of interchangeable



Post hole digger used in municipal, county and state highway construction

heads for a wide range of uses from penetrating soft earth to permafrost shale and even coral rock. Other features include rust-proof zinc plated bolts throughout and a device for easy attachment to any two or three-point hitch on tractor, jeep or other vehicle. It also has a new slip-clutch to eliminate shear-pin breakage, and an easily attached 6-in. auger extension. For complete details write the Roper Manufacturing Co., Zanesville, Ohio, or circle No. 10-2 on the reply card.

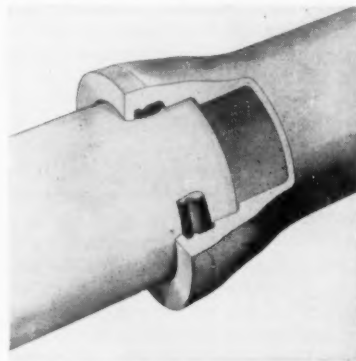
## Mechanical Spreaders For Ice Control

A new automatic clutch is simplifying the operation of chemical and grit spreaders manufactured by Fairfield Engineering. The contents of the trucks are gravity-fed to the spreading mechanism operated by 2½-hp Wisconsin gasoline engines. The automatic centrifugal clutch applies power smoothly, permits "no-load" starting of the spreader mechanism, and insures a steady

flow of the chemical or grit without jamming or stalling the motor. Damage to the engine is also prevented, since the clutch slips instantly if an excessive load or frozen chunks of de-icing materials enter the spreader. For full details write Fairfield Engineering Co., Marion, Ohio, or circle No. 10-3 on the card.

## Cast Iron Pipe With Tyton Joint

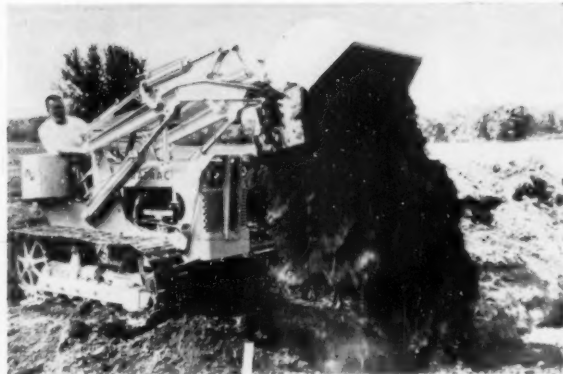
Cast iron pipe with the new Tyton joint has been developed by U. S. Pipe and Foundry. The joint has only one accessory—a circular rubber gasket. This gasket is modified bulb shape in cross section. Composition and dimensions of the gasket have been determined to assure a tight and lasting seal. The inside contour of the bell or socket provides a seat for the gasket. An internal bead in the socket fits into the groove in the gasket. The gasket is placed in the socket, its inside surface is given a light coating of lubricant and then the slightly tapered plain end of the jointing pipe is simply forced into and seated in the socket. The gasket is compressed by the plain end and the joint is made up. For more data write U. S. Pipe and Foundry Co., 3300 First Ave., North Birmingham 2, Ala., or circle No. 10-4 on the reply card.



Tyton joint is very easy to assemble



Plastic truck cover will keep out cold and rainy weather



Dumping sticky materials is no problem with this loader

### Weatherproof Plastic Cover For Light Trucks

A rugged plastic truck cover that will convert your open-bed pick-up truck to a weatherproof panel model in a matter of minutes has been announced by Glas Laminates, Inc. Designed to fit  $\frac{1}{2}$  or  $\frac{3}{4}$ -ton trucks, the one-piece cover effectively seals out rain and dust and is extremely resistant to physical shock and temperature change. It's ideal for surveyors, sewer and water maintenance men, and contractors. The basic unit is molded from glass fiber reinforced Plaskon polyester resin. Two men can mount the one-piece unit on a truck box in a simple operation. Standard models have rear door lifts and are available with or without side windows. Equipment such as bunks, shelves, sink, icebox and tables can be easily installed to suit individual specifications. Further information is available from Glas Laminates, Inc., 1979 Harbor Blvd., Costa Mesa, Calif., or circle No. 10-5 on the reply card.

### Trencher Available For Many New Model Tractors

The heavy duty Arps "trench hog" is now available for the new Ford 800, Ferguson 40, Massey-Harris 50 utility and John Deere 420W tractors. Adaptation of the trencher to these new model tractors now makes the unit widely available for operation by contractors, utility firms, municipalities and others who require a low cost, heavy duty trencher for a wide variety of jobs. It is available with three boom lengths, providing digging depths of  $3\frac{1}{2}$ ,  $5\frac{1}{2}$  and 7 feet. Quick change cutters are furnished in 6 to 20-inch widths and special cutters are available for rocky and frozen ground. Complete information is available from the Arps Corp., New Holstein, Wisc., or circle No. 10-6 on the reply card.

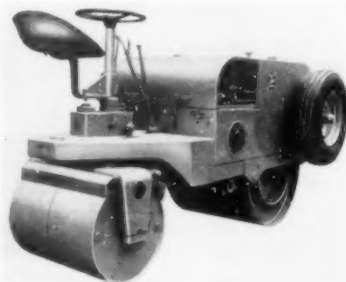
## TerraTracs Dump Fast and Clean

A new feature of the TerraTrac crawler tractor-loader is a mechanical "knockout" action, which jars wet clay, muck, etc., out of the bucket instantly at all dumping heights from 2 ft. up to full lift height. This positive "forced-ejection" method has been achieved by use of extra-large tilt-cylinders and by revamping the dumping mechanism. Another new feature which helps dislodge materials is an increase in bucket dumping angle. At low dump heights, buckets now roll over a full  $90^\circ$ , while at maximum lift height, the dumping angle has been changed to  $45^\circ$ , to gain more reach for dumping into high truck

boxes. Grading angle of TerraTrac loaders has been increased, buckets can now be rolled forward as much as  $110^\circ$  at ground level. The complete Terra-Trac line includes eight gasoline and diesel-powered crawler models, from 36.5 to 62-hp. Model "600", largest in the current line, has the additional advantages of torque-converter drive, automatic power-shifting, power-steering and power-brakes. It has four speeds forward to 6.56 mph and four reverse speeds to 7.2 mph. For further information write American Tractor Corp., Churubusco (Ft. Wayne), Ind., or circle No. 10-8 on the reply card.

### Portable Tandem Roller

A redesigned 2-3-ton portable tandem roller has just been announced by Littleford. Known as the model 157 it has a Wisconsin engine with Stellite valves; a twin disc clutch for smoother rolling operation; and manual steering has been replaced by a new horizontal type steering system which provides part-time power steering for easier operation. For complete information on Littleford rollers write Littleford Bros., Inc. Box 73, 452 E. Pearl St., Cincinnati 2, Ohio, or circle No. 10-7 on the reply card.



### "Power Voice" Mobile Speaker Uses Transistor Amplifier

A mobile communications type speaker with a built-in transistor amplifier has been announced by Motorola. The speaker elements accent voice frequencies but suppress ignition noise and other interference above and below the basic voice frequency range. Battery drain is very low, being less than 0.3 ampere on standby and 1.0 ampere with full voice output. Approximately 1 watt input to the amplifier provides 15 watts output in 12-volt vehicles and 5 watts output in 6-volt vehicles. The unit is easily removed from its mounting bracket and hung outside the vehicle window to enable monitoring of receiving messages from a considerable distance away, thus increasing its utility. The steel case is compact and weighs about 6 pounds. For complete information write Motorola Communications and Electronics, Inc., 4501 West Augusta Blvd., Chicago 51, Illinois, or circle No. 10-9 on the reply card.

### Instrument for In-Place Density Tests of Soils

Rapid density tests of soils and similar materials can be made easily using the new "Volumeasure" recently introduced by Soiltest. The instrument can be used on both research and construction projects where soils and other materials are being evaluated for natural or compacted in-place densities. The Volumeasure operates on a water filled balloon principle; water under pressure is forced into the balloon and



Instrument for testing compacted soils

the balloon completely fills the density hole. Pressure is developed by a hand operated pressure-vacuum bulb system which extends or retracts the balloon in a matter of seconds. Volume measurements are read directly on a graduated cylinder which has a 1/20-cubic foot capacity. The cylinder is precision calibrated to 0.00025 foot divisions. The unit weighs less than 13 pounds and can be carried anywhere for immediate use. For full information write Soiltest Inc., 4711 W. North Ave., Chicago 39, Ill., or circle No. 10-10 on the reply card.

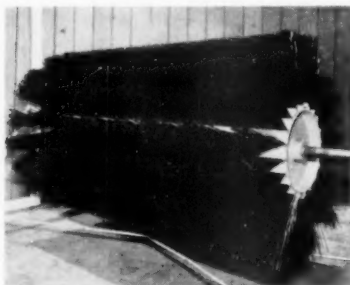
### One-Man Operated Hydraulic Crane

A new mounted hydraulic crane has been announced by McCabe-Powers. The unit, which has been designated "Load-Master", has a rated capacity of 4,000 pounds and is designed for installation on any truck chassis having a cab-to-axle dimension of at least 84-inches. All operations are hydraulically controlled by one man. Controls are normally installed on the crane superstructure to afford the op-

erator an unobstructed view of the boom at all times. The Load-Master consists of a hydraulic ram anchored to a supporting mast, a winch driven by the truck engine through a power take-off and an outrigger cylinder, with swivel-mounted foot plate, installed on each side of the truck to furnish extra stability for side loading. The Load-Master is suited for use in many utility hoisting jobs, and in line construction work for setting poles up to 45-ft. in length. More information from the Powers-American Division, McCabe-Powers Auto Body Co., 5900 North Broadway, St. Louis 15, Mo., or by circling No. 10-11 on the reply card.

### Broom for Street Sweeper

A new 1,500-mile pick-up broom for street sweepers has been introduced by Rynal Corp. Using Rynal filament, this broom was tested in over 9,000 miles of sweeping in cities across the nation. Cleaner sweeping and up to 10 times the usual sweeping mileage of brooms under similar conditions was reported. Shipped in a carton less than



Sweeper broom will last for 1500 miles

one foot square and as long as your broom, Rynal brooms eliminate the need for large storage areas, coiling equipment and extra cores. For full information write Rynal Corp., 114 St. Joseph St., Arcadia, Calif., or circle No. 10-12 on the reply card.

### Portable Pump and Motor Unit Is Light and Compact

A close-coupled, portable electric motor and pump unit, with a dry suction lift of approximately 15 feet is announced by Jabsco. It is self-priming and equipped with a neoprene impeller driven by a 1/4-hp, 1725 rpm electric motor. A vacuum switch that automatically stops the motor when the liquid supply runs dry is provided. The 1/2-in. inlet and outlet ports are designed for standard garden hose couplings and operation is on 115 AC voltage, 60 cycle, single phase. Capacity is 10

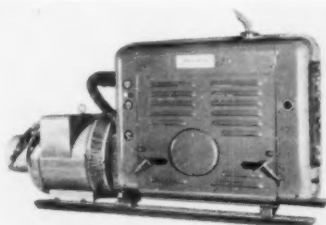
gpm against a 10-ft. head; operation is up to 20 psi pressure. The pump measures less than a foot in any dimension and weighs approximately 27 pounds. For more information write Jabsco Pump Co., 2031 North Lincoln Street, Burbank, Calif., or circle No. 10-13 on the reply card.

### Stainless Steel Filtration Package Unit

A completely new stainless steel Durco-Enzinger filtration station as a portable package unit has been announced by Duriron. The station is ideal for pilot plant or other small batch operations. The complete unit consists of a vertical leaf pressure filter with 21.2 sq. ft. of leaf area, a precoat and slurry tank, pump, valves, and complete piping, all mounted on a portable frame. The unit can be positioned and in operation in minutes. A similar package unit can be obtained from Enzinger on a loan and rental basis for filtration test purposes. For complete details write The Duriron Company, Inc., Dayton 1, Ohio, or circle No. 10-14 on the reply card.

### Gasoline Electric Plants to 75kw; Diesel to 300kw

Two new groups of gasoline electric plants have been added to the Gen-A-Matic Corp. line of generators. Both air and water-cooled models, with ratings from 400 to 75,000 watts, are now available, as well as three separate lines of diesel electric plants ranging from 10,000 to 300,000 watts. The diesel electric plants are operated by General Motors, Waukesha and International engines. Both the portable electric plants, ranging from 850 to 5,000 watts, and the Group II (non-diesel) plants currently being introduced, are available with automatic and semi-automatic control apparatus for special applications. Any desired control configuration may be specified. More information is available, from the Gen-A-Matic Corp., 14741 W. Bessemer Street, Van Nuys, Calif., or circle No. 10-15 on the reply card.



Gen-A-Matic Model 300-A electric plant generates 30 kw of steady power



### Shawnee Loader and Backhoe on Deere "420" Crawler

The new John Deere crawler is mounted with a Shawnee Loadmaster front end loader and a Shawnee Scout D7OHL backhoe. The loader has large twin bucket cylinders and is entirely mounted on the tool bars of the tractor. The 60-inch material bucket can be replaced by other attachments including a bulldozer blade. The loader has a lifting capacity of over 3,500 lbs. to a 9-foot dumping height. The backhoe has individually powered leveling "feet" and has double acting hydraulic cylinders. It operates on a dragline principle and digs to 12 feet deep, reaches to 14 feet and loads to 9-foot dumping height. Both units operate from a Hydreco crank-shaft-driven pump with the oil reservoir in the frame of the loader. For more data write Shawnee Mfg. Co., Topeka, Kans., or circle No. 10-16 on the reply card.

### Simplified Rotary Snow Plow

A new rotary snow plow for state, county and municipal snow removal, the Bros Model "B" Sno-Flyer, is suitable for any four-wheel drive truck in the 17,000 GVW range. It is front-mounted by a universal hitch that permits interchange with push plows and has a capacity for handling 20 tons of snow per minute, casting distances up to 75 feet. A chute permits rapid loading into trucks in crowded streets. The casting chute rotates 360 degrees to control placement of snow in adjacent areas. The cutting width of the plow is 8-ft. It is powered by an 8-cylinder engine mounted on the rear of a truck chassis. For full plow specifications write the Wm. Bros Boiler & Mfg. Co., Road Machinery Division, 1057 Tenth Ave., S.E., Minneapolis 14, Minn., or circle No. 10-17 on card.



Rotary plow for four-wheel drive trucks for snow removal

### Stump Ripper Takes Them Out Fast

A new stumper, the Ransome Model R100, has been introduced by the Ransome Corp. The new three-prong stumper can be attached to any bulldozer blade from 35 to 41



New three prong stump remover

inches in height. It features a positive clamping device which permits its being mounted or dismounted in a matter of minutes, freeing the bulldozer for gathering the removed stumps. No alterations to the blade are required. The unit permits the concentration of the power of the tractor and the lifting force of the bulldozer blade at the base of the stump, resulting in its quick removal with a minimum effort. Soil around the stump need not be disturbed. For more information write The Ransome Corp., 2729 Hunting Park Ave., Philadelphia 29, Pa., or circle No. 10-18 on the reply card.

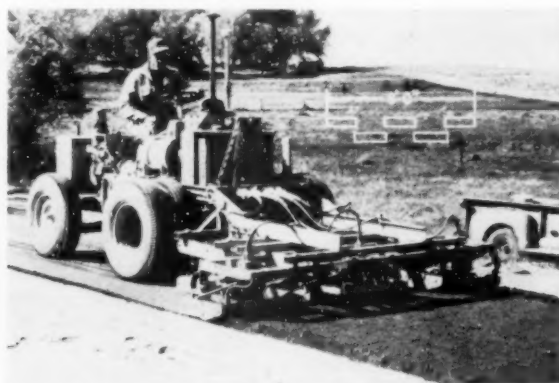
### Three Models of All-Electric Copying Machines

Three new office copying machines, a cabinet floor-stand, and two new copy papers have been announced by Minnesota Mining and Manufacturing. The new machines operate on an all-electric

principle which leaves an exact replica of the original on a special paper, produced in 4 to 10 seconds, ready for immediate use. The units, marketed under the name "Thermo-Fax", include the "Premier", table-top machine which makes it possible to copy from any material regardless of its thickness; the "Fourteen" table-top machine which copies material up to 14 inches wide, in which the copy paper and original are fed into the machine and return automatically in four to seven seconds; and a new version of the "Secretary" copying machine developed and restyled to accommodate the use of a new white copy paper. The two new copy papers are a white paper to answer particular needs in office administration, expanding the "Thermo-Fax" copy paper range to five colors; and for use in the "Fourteen" machine, for copying ledger sheets, a paper in 14 x 17-inch or 11 x 17-inch stock. For more information write Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul, Minn., or circle No. 10-19 on reply card.

### Compactor Adjustable To Width of Job

The six compacting units in the workhead of the multiple compactor made by Jackson Vibrators may be arranged and rearranged to provide the most efficient coverage and consolidation of granular soils, rock, slag, sand or gravel that are used in sub-bases, bases of macadam pavement, pavement widening, projects and fills of various kinds. The flexibility of the machine is derived from the fact that each of the units in the workhead may be independently operated. Units may likewise be arranged in tandem,



Compactor can be arranged to fit exactly an 8-foot width



three following three, for maximum one-pass consolidation; three and two staggered to fit width exactly or towed in tandem at the side of tractor for pavement widening projects. Individual compactor units may also be taken from multiple workhead, and used as self-propelled, manually guided compactors for compacting areas which are inaccessible to the large machines. The six compacting units deliver up to 4200 two-ton blows per minute. For complete details write Jackson Vibrators, Inc., Ludington, Mich., or circle No. 10-20 on the reply card.

#### Truck-Mounted Earth-Boring Machine

A truck-mounted earth-boring machine with hydraulic turntable base and swivel action that permits operation at any angle over a full 180° arc without having to move the truck itself has been introduced by

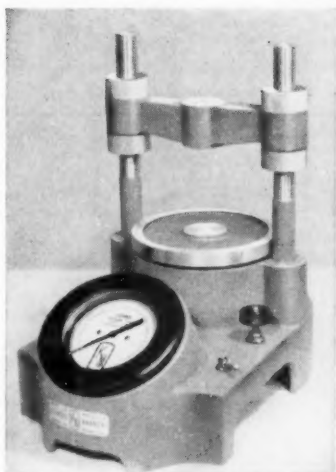


Earth-borer is easily mounted either on a single rear axle or tandem truck

Highway Trailer. It is capable of digging holes from 9 to 36 inches in diameter and up to 10 feet in depth—in any soil and on any level. It is used for construction of utility lines or foundation footings along city streets or open highways. It can also be used for digging holes for guard rail posts and for soil test borings; and it can be equipped not only to dig the holes, but also to set the poles. For full details write Highway Trailer Co., Edgerton, Wisc., or circle No. 10-21 on the reply card.

#### Portable Soil Consolidation Tester

Loads equivalent to 36 tons per sq. ft. on a 2½-inch diameter sample can be applied instantaneously with the new portable physical soil test-



Soil tester applies load equivalents to 36 tons psf on a 2½-inch diameter

ing machine introduced by Tinius Olsen. Designed to meet the demand for a higher capacity consolidation tester, this new K-W Conbel Model 352, which weighs only 40 lbs., has a maximum capacity of 2600 lbs. at 100 psi with a sensitivity of 1/3 to 1/2 percent of full load. Loads are applied by air pressure by means of a piston inside a rubber diaphragm, which eliminates a spring constant. For additional information write Tinius Olsen Testing Machine Co., 5598 Easton Road, Willow Grove, Pa., or circle No. 10-22 on the reply card.

#### Noiseless Plastic Trash Can Has Self-Locking Lid

Something new in trash cans is now available to provide sanitary storage and cut down on the noise and clutter of collections. Made of polyethylene plastic, the standard size 20-gallon cans are provided with a lock-lid cover that prevents spilling, odors, and unwelcome visits from stray animals. The can itself is unbreakable and is readily pushed back into shape after hard knocks. Its smooth, seamless interior is easy to keep clean and sanitary. Several attractive colors are offered.

These plastic cans are being tested by the city of Elizabeth, N. J., and are being used by the public works department of the cities of Long Beach, Calif., and Sarasota, Florida. They were exhibited to public works officials at the fall meeting of the New York-New Jersey Metropolitan Chapter of the APWA. For further details, write to Loma Plastics, Inc., 3000 W. Pafford St., Fort Worth, Texas, or circle No. 10-23 on the reply card.

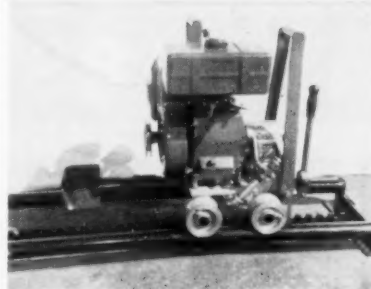
#### NEW KELLY-CRESWELL SPRAY GUN MAKES ROAD STRIPING EASIER



Kelly-Creswell Company, Xenia, Ohio, recently announced the introduction of a new automatic striping gun (shown above) for use on highway and industrial road-marking equipment. Gun is Patented. This new gun is diaphragm-operated, which eliminates the air cylinder and upper packing gland normally found in most spray guns. As a result, it eliminates the greatest cause of air loss in automatic spray guns. Actually, the new gun requires about 25% less compressed air to operate at peak efficiency. The gun is being installed on all of the various types of striping equipment made by Kelly-Creswell. It also is available as a replacement part. Kelly-Creswell is a pioneer manufacturer of a complete line of road-marking equipment—truck-mounted, power driven and hand operated.

For additional information write  
**Kelly-Creswell Company**  
Xenia, Ohio

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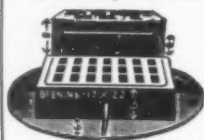
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### Research in Water and Waste Disposal

Two research grants have been awarded by the National Institute of Health to Michigan State University, totalling \$31,000. Dr. Robert F. McCauley will conduct a two-year study of methods of protecting water pipes from rust and corrosion; and fundamental research on composting will be carried on by Drs. Karl L. Schulze, W. L. Mallman and R. F. McCauley.

### Sanitary Engineer with Design Experience is Available

A sanitary engineer, 41 and single, presently employed by a government agency on the design of water supply and distribution systems and on sewage and waste disposal, is available. He has a BA in Chemistry; MS in Sanitation; and expects a doctorate in Engineering this fall. Prefers location in eastern part of country. Write DG, Box 10-1, Public Works, 200 S. Broad St., Ridgewood, N. J. Letters will be forwarded without acknowledgement.

### Sanitary Engineers Needed

The Public Health Service requires a number of well-qualified sanitary engineers to aid in the review of applications for and approval of grants to municipalities under the new stream pollution law. Construction and design experience is desired. Salaries start at \$7035 and there are openings at higher salaries. Contact the Public Health Service, Washington 25, D. C.; or write to any Regional Office. In the northeast apply to S. C. Martin, Public Health Service, 42 Broadway, New York, N. Y. There will be openings in almost all sections of the country.

### Engineers Needed by Army Engineers

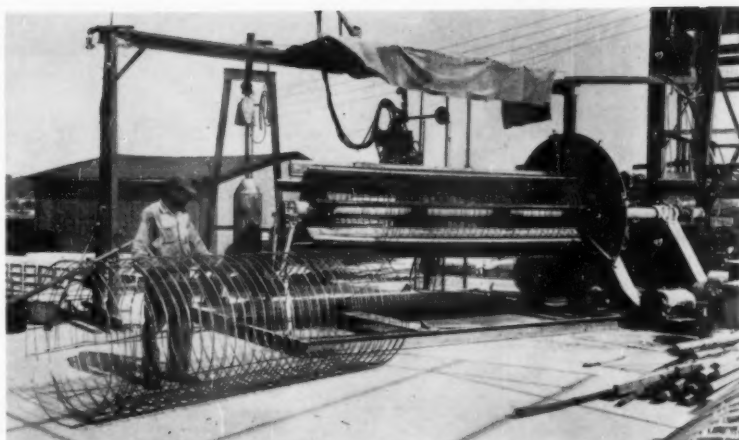
New York District Corps of Engineers has a critical need for engineers on military and civil construction projects. There are vacancies in New York City and in New York State. Salaries are \$4400 to \$7035 starting; experience required 0.5 to 2.5 years. Write Personnel Branch, C of E, 111 E. 16th St., New York 3, N. Y., or call SPpring 7-4200, Extensions 349 or 350.

## Reclaiming Air Conditioning Water

Air conditioning has created a problem according to Robert Enzweiler, Supt. of Utilities, Park Forest, a new community approximately seven years in age, with a population of 25,000. Well water has been used in the air conditioning system with the effluent from the air conditioning units being discharged to the storm sewer until recently. The water supply source for domestic use became inadequate and it was anticipated that another well would be necessary in order to obtain an additional 900 gpm. A scheme was developed, however, whereby air conditioning water was produced from one well; pumped through a cooling tower, and re-pumped to the raw water coming to the regular treatment plant. The new system accomplished its purpose and resulted in one additional well to augment the present source of domestic water supply. In the event of a breakdown in the shopping center air-conditioning unit, treated water could be used. The collecting system and cooling tower for reclaimed water cost \$110,000. This plan resulted in a saving of about 30 percent over the cost of developing an entirely new source. The following figures were given for the months of May through September; water plant total output was 343,900,000 gallons, of which 180,000,000 gallons were pumped from the air conditioning well and 39,200,000 gallons were reclaimed from the air conditioning system. Reclaimed water from the air conditioning unit helped in the coagulation of the water in the softening plant where hardness is reduced from 35 grains to 5 grains. These data were presented in a panel discussion at the Illinois Annual Water Plant Operators' Conference.

## Oklahoma Gas & Electric Buys Turbine Generator

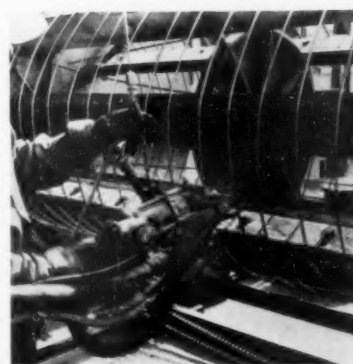
The growing demand for electricity in Oklahoma continues to be met by the Oklahoma Gas & Electric Co. with the order of a 150,000-kw turbine generator from the Westinghouse Electric Corporation. Costing approximately \$4,000,000 when installed the unit will generate enough electricity to supply the needs of an area almost twice the size of Oklahoma City. The unit is scheduled for delivery in August, 1958, and in operation the following year at a location which has not been announced by Oklahoma Gas & Electric Co.



● COMPLETED cage has two concentric layers of reinforcing wires and stiffeners.

## Wire Forming Unit Speeds Concrete Pipe Making

REINFORCED concrete pipe is used largely in highway drainage and storm sewerage systems. A problem has been the need for storing bulky rolls of wire mesh of various sizes, since the various pipe sizes often require different mesh dimensions. N. C. Products, a supplier of such pipe in Raleigh, N. C., has solved this problem by using a Sturdevant wire forming unit. This will form the reinforcing cages described in most specifications from two sizes of wire, No. 1 and No. 4/0, reducing markedly the stock variety required to be kept on hand, and also the warehouse space.



● JOINTS in wire cage are welded.

## Sanitary Fill Will Enlarge This Golf Course

A BIGGER golf course is the future prospect for players at the Flint Hills Golf Course, Burlington, Iowa. Through cooperation between golf course officials and the city, gulleys and broken ground adjacent to the existing nine-hole course are being leveled by the sanitary landfill method; eventually the filled area will provide space for construction of an additional

nine holes on the reclaimed land.

The landfill method at Burlington is five years old. Four city trucks plus seven private companies make pick-ups, and a Caterpillar No. 955 Traxcavator is used by the City of Burlington on the sanitary landfill project. Fill in one gully where work has been completed measures 125 yards long by 50 yards wide and is up to 50 feet deep.





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U. S. Pipe & Foundry Co.	85
United Steel Fabricators, Inc.	80
Wallace & Tiernan Incorporated	Back Cover
Watkins, J. Stephen	200
Whitman, Requaert & Assoc.	200
Williams & Associates, Clyde E.	137
Willis Motors, Inc.	85
Woodward Iron Co.	80
Worthington Corporation	200
Wright Engineers	200



# Worth Seeing



No goat ever had the appetite for everything loose that a jet plane has. Stray bolts, nuts and metal scraps are sucked into its engines with costly results. This Conveyor Mobil Sweeper at the Jacksonville (Fla.) municipal airport is equipped with battery-powered electric magnets to pick up all loose metal.



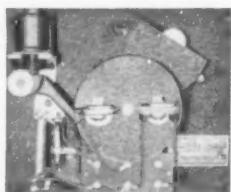
The maximum in traffic violation is contained in this Colorado Springs picture. A Fire Chief's car is parked before a Mueller 3-way fire hydrant beside a parking meter reading "Expired." Defense counsel argued that when a hydrant had three separate hose outlets on it, just one car constitutes no real impediment to firemen. "Next case!"



Drawing on an inverted ink-well and the tripods of photographers and surveyors for design, Chicago Bridge and Iron Co. comes up with this modern, low-cost, limited capacity tank at Brae Burn Country Club, Bellaire, Texas.

This is the St. Lucie Canal bridge, largest on the Miami to Fort Pierce section of the Sunshine State Parkway. Steel beams linking the piers are 85 feet long; those carrying the turnpike over the canal, 140 feet. Concrete deck has been laid on half of this section of the bridge. Photo courtesy of the Florida State Turnpike Authority.





## TYPE A ROTO-TROL

A pressure operated device for controlling, within small and exact limits, the high and low elevation of a water line in an elevated tank, standpipe, or reservoir. Usually located in pump house. Takes pressure connection from pump discharge line. Has built-in electric time delay device that prevents starting and stopping surges from cutting the pump in and out at each pumping cycle.

WATER LEVEL CONTROLS  
DIVISION

HEALY-RUFF COMPANY  
791 Hampden Ave., St. Paul 4, Minn.

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640 COLUMBIA AVE.  
DARBY, PA.



## WORTH TELLING

by Arthur K. Akers

★ **WHITE MOTOR CO.**, Cleveland, advances Roy A. Fryer to advertising manager; David W. Sheehan to sales promotion manager.

★ **W. D. CRAIG** now heads Esso Standard Oil Company's Asphalt Division in New York. He was author of the first Asphalt Institute Handbook, in 1926.

★ **MEET Gary F. Davis**, new director of sales, the Ernest Holmes Co., Chattanooga, succeeding Harry C. Gould, retired. The Holmes Owen truck loaders are the product sold heavily in the public works field.



Mr. G. F. Davis



Mr. Evans

★ **DRESSER MANUFACTURING** Division, Bradford, Pa., announces Charles H. Evans as manager for their water and sewage treatment sales. He was formerly branch manager of Rensselaer Valve Co., in Chicago.

★ **JOHN KILMER**, chief engineer, Golden-Anderson Valve Specialty Co., Pittsburgh, fathers a special automatic valve in the water cooling system for a guided missile launching pad at a Florida air base. The pad uses more water than a small city.

★ **LACKING DATA** at the time, we inadvertently omitted crediting the picture of the blast furnace used in our own August "Modern Industry Depends on Public Works" ad to U.S. Pipe and Foundry Co., Birmingham. It showed one of four furnaces owned by them. Incidentally, they are building still another, to produce more pig iron for more U.S. centrifugally-spun cast iron pipe. Added note: John Madden, Jr., suc-

ceeds George T. Overholt, retired, as sales agent in their New York office.

★ **DAVID J. DAVIS** steps into the newly-created position of general sales manager, Construction Machinery Division, Gar Wood Industries, at Findlay, Ohio.



Mr. D. J. Davis



Mr. Parker

★ **JAMES R. PARKER** is helping to man the Ford Meter Box Co. eastern sales front out of Haddonfield, N.J. while Dick Ford serves as Director of Water and Sewage Division, Department of Commerce, in Washington.

★ **IF YOU SEE** a monster corrugated steel pipe rolling down the highway don't be alarmed. It is the new demonstration trailer of the Armco Drainage and Metal Products on its nation-wide rounds, filled with exhibits of Armco products.

★ **THE HOLLY CORPORATION** of New York, having acquired The Preload Company, Inc., names Melton L. Bass, recently an officer of the Raymond Concrete Pile Co., as president of Preload.

★ **LT. GEN. EUGENE REYBOLD** (ret.) has been appointed special representative in Washington for the Jay Company Division, Columbus, makers of asphalt tamping and cutting equipment. He was formerly executive vice president of the A.R.B.A.

★ **A TRUCK DRIVER** pulled up alongside one of those tiny foreign cars stalled on the highway. "What's the trouble, pal?" he grinned. "Need a new flint?"



The 544 loads snow at 7-11 cu. yd. per min. Or loads coal or leaves . . . or converts to the lowest-cost way to load aggregate from stockpile to truck. A 15 m.p.h. road speed and a hydraulic truck trimming conveyor boost speed and efficiency on any job.

## Snow loaders that pay off all year 'round

Big snows are costly. Traffic gets jammed . . . fire trucks and police cars are blocked . . . business drops off. Time and money are lost.

But snow removal is costly. For most cities and towns it's too costly to maintain single-purpose snow removal equipment.

Barber-Greene multipurpose loaders solve this

problem neatly and economically. As snow loaders, these machines have the high capacity and easy maneuverability to open up snowbound communities in a hurry. Between snow seasons, these versatile Barber-Greens handle coal or easily convert to leaf and aggregate loaders to extend their efficiency to a year-round basis.



The 550 loads snow at 6 cu. yd. per min. As a windrow loader, its capacity is 4 cu. yd. per min., which keeps it ahead of all trucks normally available. Highly maneuverable, with a 10 m.p.h. road speed and a turning radius of only 8'6".

Write for details on these all-season loaders today.

56-24-L



# Barber-Greene

AURORA, ILLINOIS, U.S.A.



CONVEYORS...LOADERS...DITCHERS...ASPHALT PAVING EQUIPMENT

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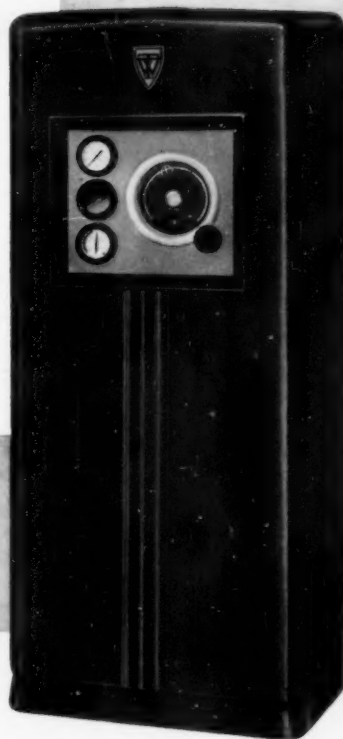
**V-NOTCH**

variable-orifice

CHLORINATORS



A-711 V-notch Chlorinator  
has rotameter indicator  
with 10 to 1 feed range



A-712 V-notch Chlorinator  
has dial indicator with  
20 to 1 feed range

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## *V-notch Chlorinators* **SIMPLIFY** *Chlorination*

With the new Wallace & Tiernan V-notch Variable-Orifice Chlorinators:

**OPERATION IS SIMPLIFIED** as one injector control starts or stops the unit. Chlorine gas is turned on or off automatically.

**SETTING FEED RATE IS SIMPLIFIED** as one control sets feed rate precisely at both high or low feeds.

**INSTALLATION IS SIMPLIFIED** as units are

shipped ready for operation. No water supply is needed at the chlorinator. A remote injector uses only standard water supply fittings.

**MAINTENANCE IS SIMPLIFIED** and virtually eliminated. All parts are corrosion resistant, mounted in an attractive modern cabinet.

For full details on manual or automatic proportional V-notch Chlorinators, contact your W&T representative, or write to the address below.

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